MACHINERY
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DESIGN OF AUTOMOBILE TRANSMISSION GEARS—1

By M. TERRY*

STRICTLY speaking, clutch, speed-changing mechanism, universal joints, propeller shaft, differential, etc., have equal legitimate rights to the term "transmission"; however, the term, as used at present, applies only to the speed-changing device.

The first automobiles built lacked this important detail, and the driver controlled the speed of his car by varying the speed of its engine. To-day, transmission is an essential part of self-propelled vehicles. The sole object of transmission is to vary the relative speeds of the propeller and engine shafts. In general, this object is accomplished either by means of friction disks or by a set of gears of varying diameters. Of the two, the gears seem to have the lion's share of the field. The manner in which the gears are engaged to transmit power is the distinguishing feature of the various gear transmissions. We have planetary, sliding-progressive, sliding-selective, and non-sliding—each of them possessing advantages and disadvantages over other types. In the present article the author will attempt to discuss a few of the main principles common to all gear transmissions.

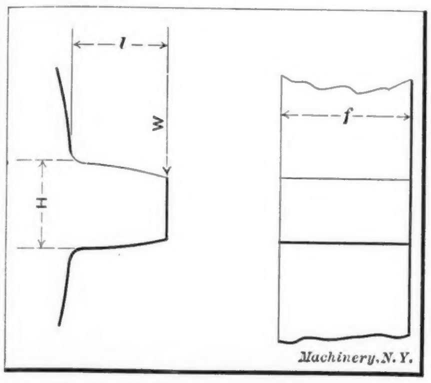


Fig. 1. Automobile Transmission Gear Stub-tooth as a Cantilever

With the data that a transmission designer is usually given, he first has to find the ratio of the various gears, their pitch and their face, and it usually takes a great deal of figuring and judgment to arrive at suitable proportions. As a matter of fact, judgment based on experience is of far greater importance than all the formulas in textbooks on machine design. The following incident may be of interest to those who are inclined to doubt this statement.

A certain firm was lately marketing an up-to-date car which sold largely on its mechanical merits. The car had a clutch of the disk type. A short time ago the firm decided to try out a cone clutch. Accordingly, one completely interchangeable with the disk clutch was built and installed in a test car. "Personal element" was practically eliminated; both clutches were designed by the same man, built in the same shops, and installed in like cars with like engines and transmissions.

In its first trial the cone clutch completely demolished the transmission which had never given any sign of trouble with the disk clutch. It is beyond the scope of this article to discuss the relative merits of the two clutches; the fact is merely stated to demonstrate the existence of one important element not subject to calculations—namely, shocks. A transmission suitable for a six-cylinder engine, may cause trouble on a four-cylinder and be a complete failure on a two-cylinder, the horsepower and the revolutions per minute of the three engines being precisely the same.

However good a designer's judgment may be, he must seek confirmation of his guess in figures. This becomes absolutely necessary when the horsepower of the car rises above 40, and in special racing cars where horsepower may vary anywhere from 80 to 225, the calculations are to be relied on in preference to the judgment.

The well-known and largely-used Lewis formula for gears

$$W = s\,p\,f\,y$$

cannot be applied to transmission gears, for the reason that automobile practice brought out a new type of gears called stub-tooth. Thus, an 8-10 pitch stub-tooth gear is one whose diametral pitch is 8 but whose addendum and dedendum are those of the regular 10-pitch gear. This combination gives a decidedly stronger tooth, for, considering each tooth as a cantilever, it is clear that for the same allowable stress the shorter tooth can transmit more power.

In the above formula

W = load transmitted by the teeth, in pounds,
s = safe working stress of the material,
p = circular pitch,
f = face, in inches,
y = a factor depending on the form and number of teeth.

The existing tables for different values of y cannot be applied to stub-teeth. In the absence of better formulas, the author prepared a table for the factor y, which in connection with the Lewis formula seems to give satisfactory results.

The derivation of this table is rather simple. Considering each tooth as a cantilever the following formula can be applied:

$$W\,l = \frac{s\,f\,H^2}{6}$$

where W, s and f have the same meaning as in the Lewis formula, and l and H are clear from Fig. 1.

By changing from the regular 20-degree involute tooth to the 20-degree involute stub the only values affected are those of W and l. (H is slightly affected, too, but it can be neglected.) Since W varies inversely as l, it is clear that the load-carrying capacity of a 6-8 pitch stub-tooth is to an ordinary 6-pitch tooth as 8:6. Likewise:

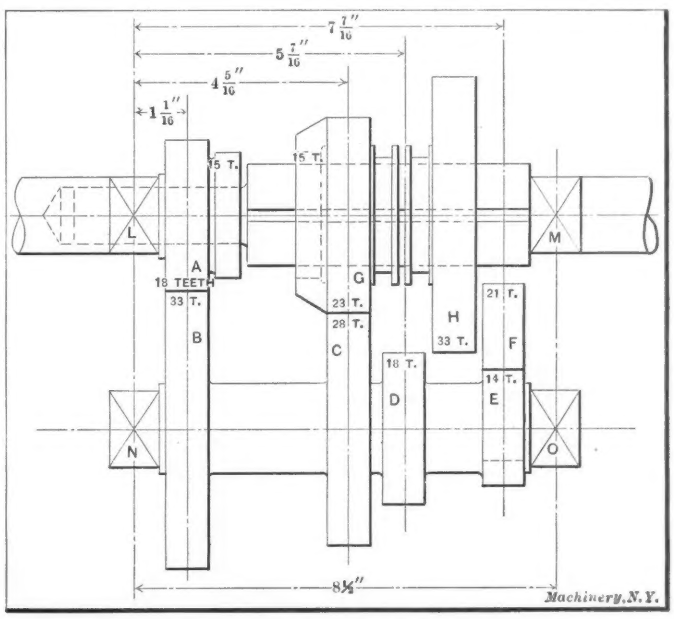


Fig. 2. Typical Automobile Transmission Gear of Sliding-selective Type

$$\frac{W \text{ of 5-7 pitch stub-tooth}}{W \text{ of 5 pitch tooth}} = \frac{7}{5}, \text{ etc.}$$

The following pitches are commonly used in automobile work: 4-5, 5-7, 6-8, 7-9 and 8-10—all 20-degree involute. Taking the values assigned by Lewis to y (Kent's Mechanical Engineers' Pocket-Book, p. 901 and MACHINERY'S Data Sheet No. 22, July, 1903), and multiplying them by the ratio of the levers, we obtain the following table:

* Address: 302 Williams St., Flint, Mich.

TABLE I. VALUES OF y FOR STUB-TEETH

No. of Teeth	20° Involute Stub-tooth—Pitch				
	4—5	5—7	6—8	7—9	8—10
12	.097	.109	.104	.100	.097
13	.104	.116	.110	.106	.104
14	.110	.123	.117	.113	.110
15	.115	.129	.122	.118	.115
16	.117	.131	.125	.121	.117
17	.120	.134	.128	.123	.120
18	.122	.137	.130	.126	.122
19	.125	.140	.133	.128	.125
20	.127	.143	.136	.131	.127
21	.130	.145	.138	.134	.130
23	.132	.148	.141	.136	.132
25	.135	.151	.144	.139	.135
27	.139	.155	.148	.142	.139
30	.142	.159	.152	.146	.142
34	.147	.165	.157	.152	.147
38	.152	.171	.162	.157	.152
43	.157	.176	.168	.162	.157
50	.162	.182	.173	.167	.162
60	.167	.187	.178	.172	.167
75	.172	.193	.184	.177	.172
100	.177	.199	.189	.182	.177
150	.182	.204	.194	.188	.182
300	.187	.210	.200	.193	.187
Rack	.192	.216	.205	.198	.192

The value of W.—To obtain the value of W, the following formula is commonly used:

$$P\,R = 63{,}024\,\frac{\text{H. P.}}{\text{R. P. M.}} = T = \text{torque}$$

where P = tangential force, R = pitch radius of the gear.

In attempting to design gears that will stand up to the worst conditions of service, a designer invariably chooses the maximum horsepower and the corresponding revolutions per minute. While the error may not be great, the idea is erroneous, for the maximum torque does not occur at the maximum horsepower.

To obtain the maximum torque, an actual engine test is necessary. The data required are only those of horsepower and revolutions per minute, and from these a torque curve may be readily plotted. Having found the maximum torque, the value of P is obtained by dividing the torque by R.

$$P = \frac{T}{R}$$

As there are always two pairs of teeth in mesh, W is never equal to P.

$W = K\,P$, where K may vary from ½ to 1. In accurately cut automobile gears K may be safely assumed not to exceed 0.6.

Lack of knowledge of the value of s.—The material commonly used for transmission gears is 3 1/2 per cent nickel-steel alloy. As the horsepower of the car increases, chrome-nickel and chrome-vanadium steels are resorted to. These alloy steels possess high elastic limits, which are raised still higher by the special heat-treating methods to which all finished gears are subjected. The elastic limits of these heat-treated materials are well known, and by selecting the proper factor of safety, the value of s is readily obtained. This method, however, takes no account of the speed at which the gears are run. What is sadly needed at the present moment is a set of reliable tables of safe stresses for these alloy steels when run at speeds varying from 500 to 3000 feet per minute. The lack of information on this point is, however, made up as explained later.

Solving for f.—All factors involved in the Lewis formula are now either known or assumed; it remains to solve for f—face of gears. For obvious reasons, designers concentrate their attention on the slow gear. Although the reverse gear is usually subjected to a somewhat greater stress than the slow gear, it can be neglected, for it is used but seldom, and then only for short periods of time.

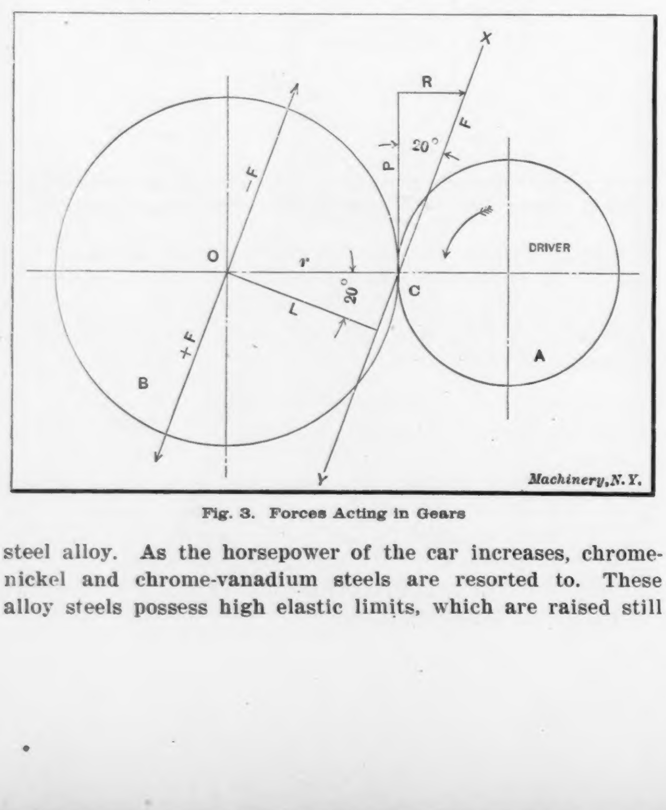


Fig. 3. Forces Acting in Gears

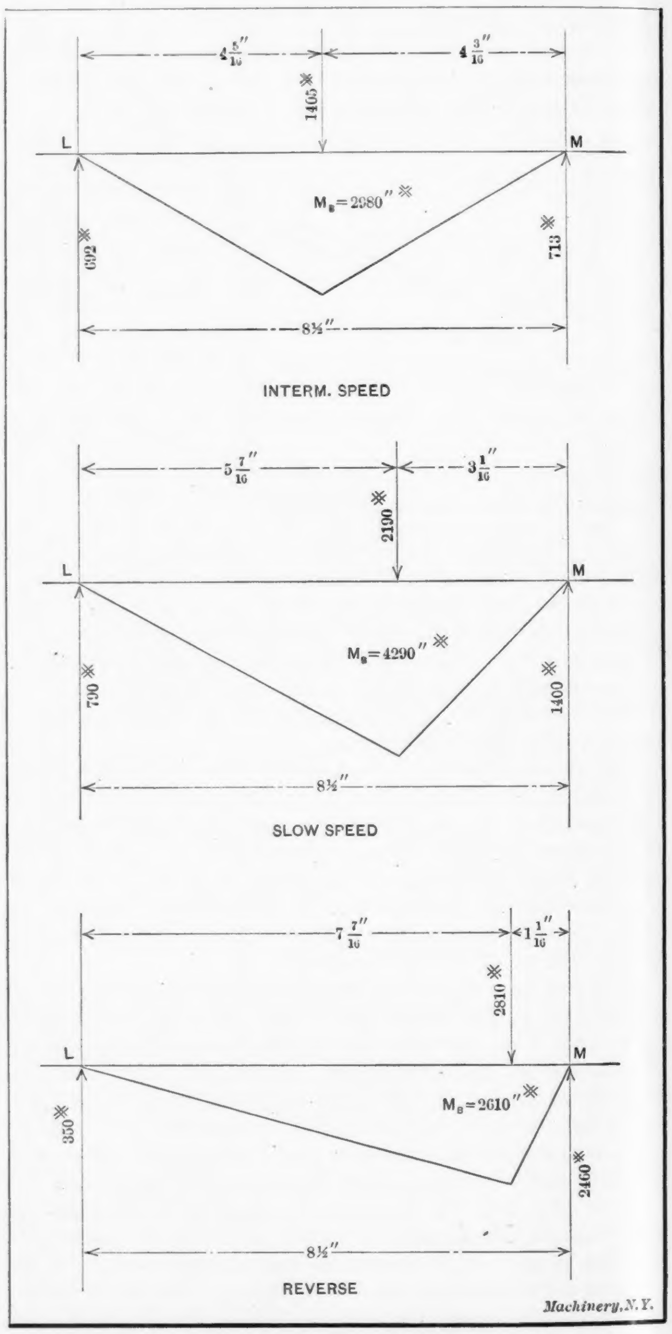


Fig. 4. Bending Moments in Transmission Shafts for Intermediate, Slow Speed and Reverse

The required width of the slow gear being found, the rest are made of the same width. At first glance this may seem to be inconsistent with principles of good design, but a little thought will show that there is a good reason back of it.

While the pressure on the teeth of the slow gear is considerably greater than that on other gears, its peripheral speed is smaller in the same proportion. The safe unit stress for a given material drops off very rapidly with increase of speed.

Thus the practice of making all gears of the same width seems to compensate for their great range of speed.

Factor of Safety

What is the proper factor of safety for transmission gears? The author is inclined to believe that a factor of 4, when used in connection with the Lewis formula, will give satisfactory results. He realizes that this factor is altogether too low, and from certain data at his disposal he is positive that the actual, existing factor of safety is much higher. The trouble lies with the Lewis formula. As stated before, it is used for want of a better one. Nevertheless, it can be successfully applied when proper values are assigned to various constants. When thousands of transmissions of various types give satisfactory service, and the rare cases of their breakdown and invariably due to the driver's carelessness in shifting gears and engaging the clutch, it may be assumed that they are reasonably safe. These gears when analyzed by means of the Lewis formula seem to have a stress equal to about one-fourth the elastic limit; hence, the conclusion regarding the factor of safety.

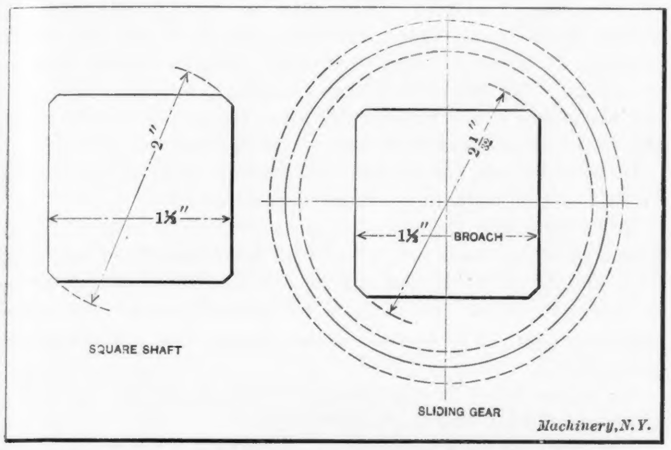


Fig. 5. Square Shaft and Sliding Gear used in Common Types of Transmissions

A problem taken from actual practice and completely worked out will serve to illustrate the principles involved in calculating gears, shafts, bearings, etc.

Specifications are as follows:

Maximum torque is developed at 1200 R. P. M.

Corresponding H. P. = 32.

Engine: 4-cylinder; 4½-inch bore; 5-inch stroke.

Clutch: Cone type.

Type of transmission: Sliding-selective.

Speeds required: Three forward and a reverse. High speed obtained by direct drive; intermediate speed = 65-70 per cent of the high speed; slow speed = about 30 per cent of the high speed.

Gears to be of 6-8 pitch, unless inconsistent with the requirements of strength.

Material for gears: 3 1/2 per cent nickel steel.

Gears

The first thing to do is to find suitable pitch diameters (or number of teeth) that will give the desirable speed ratios. By a cut-and-try method we obtain the number of teeth for each gear as indicated in Fig. 2.

$$\text{Intermediate speed} = \frac{18}{33} \times \frac{28}{23} = 66\tfrac{1}{2} \text{ per cent of high speed.}$$

$$\text{Slow speed} = \frac{18}{33} \times \frac{18}{33} = 29.8 \text{ per cent of high speed.}$$

$$\text{Torque on } A = 63{,}024 \times \frac{32}{1200} = 1680 \text{ inch-pounds.}$$

$$\text{Torque on } B \text{ (and consequently on } D) = 1680 \times \frac{33}{18} = 3080$$

inch-pounds $= T$.

Since the pressure on the pitch lines of gears D and H is the same, our calculations must be based on D since by virtue of having fewer teeth than H, it is the weaker of the two. (Consult Table I.)

$$\text{The radius of } D = \tfrac{1}{2} \times \frac{18}{6} = 1\tfrac{1}{2} \text{ inch} = R$$

$$P = \frac{T}{R} = \frac{3080}{1.5} = 2050 \text{ pounds}$$

$$W = 0.6 \times 2050 = 1230 \text{ pounds.}$$

$$y = 0.130.$$

$$p = \frac{\pi}{6}$$

$$s = \frac{85{,}000}{4} = 21{,}250 \text{ pounds.}$$

The elastic limit of heat-treated 3 1/2 per cent nickel steel is in the neighborhood of 85,000 pounds; factor of safety = 4.

$$W = s\,p\,f\,y$$

Transposing

$$f = \frac{W}{s\,p\,y} = \frac{1230}{21{,}250 \times \pi/6 \times 13/100} = 0.85 \text{ inch.}$$

Therefore all gears are made ⅞-inch wide.

By making due allowances for clearances between the gears and the probable width of the ball bearings on which the shafts are to be mounted, the distance between the points of support is practically settled.

Both shafts are subject simultaneously to twisting and bending moments.

In Fig. 3, P stands for tangential pressure. The path of contact and direction of pressure are represented by the line $X\,Y$ which passes through the point of contact of the pitch circles and makes an angle of 20 degrees with P. The total pressure F along this line is the geometrical sum of tangential pressure P and radial pressure R, P and R being at right angles to each other. Their resultant F is the hypothenuse of a right-angle triangle. Expressed in terms of P

$$\frac{P}{F} = \cos 20 \text{ degrees}; \quad F = \frac{P}{\cos 20 \text{ degrees.}}$$

By introducing at O (center of the gear B) two equal and opposite forces each equal to F and parallel to it, the balance of forces is not disturbed. But F at C and $-F$ at O form a couple or moment whose arm is L.

This moment produces rotation of the gear B against resistance offered at the other end of the shaft, thus tending to twist the shaft.

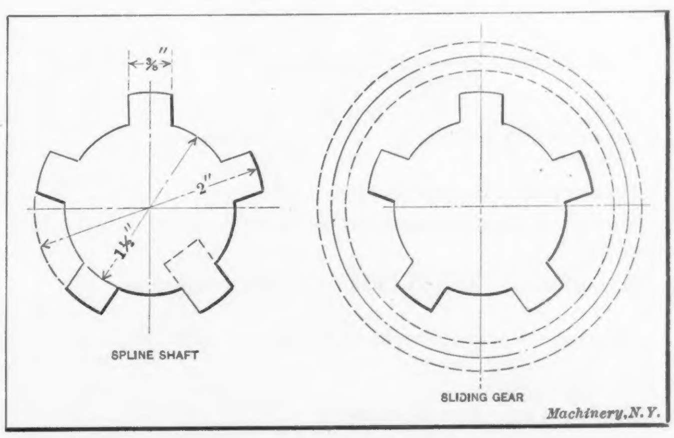


Fig. 6. Splined Shaft and Sliding Gear used in High-grade Transmission

The twisting moment $= M_T = F \times L$.

L is at right angles to XY, thus making 20 degrees with r; therefore,

$$L = r \cos 20 \text{ degrees.}$$

$$M_T = F \times L = \frac{P}{\cos 20 \text{ degrees}} \times r \cos 20 \text{ degrees} = Pr,$$

i. e., twisting moment on the shaft = torque on the gear. The force $+F$ at O produces a bending moment on the shaft and puts pressure on the bearings. The magnitude of this pressure as well as of the bending moment depends on the distance of the particular gear from the bearings.

Sliding Gear Shaft

High speed.—Since the high speed is obtained by a direct or through drive the shaft is subject only to a twisting moment numerically equal to that of the engine shaft or gear C.

Twisting moment $= M_T = 1680$ inch-pounds.

Bending moment $= M_B = 0$.

Pressure at L and $M = 0$.

Intermediate speed.—Twisting moment $= M_T = 1680 \times \frac{33}{18} \times \frac{23}{28} = 2530$ inch-pounds.

Radius of gear $G = \frac{1}{2} \times \frac{23}{6} = \frac{23}{12}$ inch.

Tangential pressure on pitch line $= 2530 \times \frac{12}{23} = 1320$ pounds.

Total pressure (combined tangential and radial) $= F = \frac{P}{\cos 20 \text{ degrees}} = \frac{1320}{0.93969} = 1405$ pounds.

Pressure at $M = 1405 \times \frac{4\ 5/16}{8\frac{1}{2}} = 713$ pounds.

Pressure at $L = 1405 - 713 = 692$ pounds.

Maximum bending moment $= M_B = 692 \times 4\ 5/16 = 2980$ inch-pounds. (See Fig. 4.)

The twisting and bending moments are combined according to the following formula:

$T_E = M_B + \sqrt{M_B{}^2\ M_T{}^2}$ (Unwin's Machine Design, Part I, p. 268) where T_E is the equivalent twisting moment. It is the theoretical twisting moment whose straining action is equivalent to that of the existing bending and twisting moments.

$T_E = 2980 + \sqrt{2980^2 + 2530^2} = 6980$ inch-pounds.

Slow Speed.—Twisting moment $= M_T = 1680 \times \frac{33}{18} \times \frac{33}{18} = 5650$ inch-pounds.

Radius of gear $H = \frac{1}{2} \times \frac{33}{6} = 2\ 3/4$ inches

Tangential pressure on pitch line $= 5650 \div 2\ 3/4 = 2055$ pounds.

Total pressure $\frac{2055}{0.93969} = 2190$ pounds.

Pressure at $M = 2190 \times \frac{5\ 7/16}{8\frac{1}{2}} = 1400$ pounds.

Pressure at $L = 2190 - 1400 = 790$ pounds.

Maximum bending moment $= 1400 \times 3\ 1/16 = 4290$ inch-pounds.

$T_E = 4290 + \sqrt{4290^2 + 5650^2} = 11{,}390$ inch-pounds.

Reverse.—Twisting moment $= M_T = 1680 \times \frac{33}{18} \times \frac{33}{14} = 7260$ inch-pounds.

Radius of gear $H = 2\ 3/4$ inch.

Tangential pressure $\frac{7260}{2.75} = 2640$ pounds.

Total pressure $= \frac{2640}{0.93969} = 2810$ pounds.

Pressure at $M = 2810 \times \frac{7\ 7/16}{8\frac{1}{2}} = 2460$ pounds.

Pressure at $L = 2810 - 2460 = 350$ pounds.

Maximum bending moment $= 2460 \times 1\ 1/16 = 2610$ inch-pounds.

$T_E = 2610 + \sqrt{2610^2 + 7260^2} = 10{,}325$ inch-pounds.

The results of all these calculations are tabulated in Table II for future reference.

TABLE II. TWISTING AND BENDING MOMENTS AND TANGENTIAL PRESSURES IN TRANSMISSION

Speed	M_T in inch-pounds	M_B in inch-pounds	T_E in inch-pounds	Pressure at L, pounds	Pressure at M, pounds
High........	1,680	0	1,680	0	0
Intermediate	2,530	2,980	6,980	692	713
Slow........	5,650	4,290	11,390	790	1,400
Reverse.....	7,260	2,610	10,325	350	2,460

Square and Spline Shafts

Sliding gear shafts are made in two varieties: square and spline (Figs. 5 and 6). The latter is usually met with on higher grade cars. Being the more expensive of the two to produce, it constitutes an important "talking point" for the salesman. The buyer of a high-grade car, forever anxious to get his money's worth and fully alive to the costly feature of the spline shaft, invariably expects to find one on his car.

In what follows the author will attempt to present the case of both shafts from the designer's point of view.

Any automobile transmission is as compact a piece of mechanism as can be made consistent with requirements of strength. The amount of metal that can be removed from sliding gears to make room for the shaft is naturally limited. The question, then, is: Which shaft is the stronger for a given available space?

So far as space is concerned the square and spline shafts shown in Figs. 5 and 6 are alike.

The polar moment of inertia of the spline shaft $= 0.860$, approximately.

The polar moment of inertia of the square shaft $= 830$, approximately.

Of the two, then, the spline shaft seems to be the stronger. On the other hand, while the square shaft is subject to bending and twisting alone, the spline shaft is subject to an additional stress, namely, shear on the keys.

The spline shaft possesses a few other disadvantages which must be considered. It has sharp corners which are undesirable in the hardening process. It can be ground on the outside of the keys only. Since the flanks of the keys are merely machined and the keys are liable to warp in hardening, the fit of the spline shaft is by no means as good as the one that can be obtained with the square shaft whose broad faces can be ground to one-thousandth of an inch. Other things being equal, shocks are more injurious to parts having "play" rather than to those having a nice fit.

To overcome this objection, some makers resort to inserted keys (as shown dotted in Fig. 6), but this at once reduces the strength of the spline shaft below that of the square. It is rather hard to make a comparison of the two shafts. In the author's opinion it is a case of "six of one and half-a-dozen of the other."

* * *

DURALUMIN, NEW ALUMINUM ALLOY

Duralumin is a new alloy of aluminum discovered by H. B. Weeks, head chemist at Vicker's Sons and Maxim's Works, Barrow, England. The alloy is described as a little heavier than pure aluminum, but as strong as steel. The firm is building new works at Birmingham for the purpose of manufacturing the metal, which has been patented throughout the world. Mr. Weeks declares that his alloy can be rolled, drawn, stamped, extended or forged at suitable temperatures, and that it is much less easily corroded than other aluminum alloys, and possesses such valuable properties that the firm thinks there is bound to be a large demand for it. It is only one-third the weight of brass, and the purposes for which it can be used are, it is said, practically unlimited.

* * *

It is stated that the American Society of Swedish Engineers intends to raise a monument with inscription on the place where John Ericsson's house in New York was situated. It is intended to unveil the monument on November 23, the anniversary of John Ericsson's arrival in New York.

INTERCHANGEABLE INVOLUTE GEARING*

By WILFRED LEWIS

After a more or less unsatisfactory experience with cycloidal gearing, I investigated about twenty-five years ago the subject of involute gearing with the object of determining upon a system for the firm of Wm. Sellers & Co., Inc., with which I was then connected. The conditions imposed called for a system applicable to any number of teeth between a 12-toothed pinion and a rack, without change in the Sellers addendum which had always been made 0.3-pitch for the cycloidal teeth hitherto used almost exclusively by them.

I found that the involute forms then in vogue were confined to obliquities of 14½ degrees and 15 degrees with an addendum equal to the modulus, or about 0.32-pitch. This long addendum with such small obliquities naturally gave rise to interference between racks and pinions of less than 30 teeth, and rather than modify the involute form I finally recommended the adoption of a pressure angle of 20 degrees. At the same time, I was well aware of the fact that even this obliquity was not sufficient to prevent interference between a 12-toothed pinion and a rack, but for such pinions and gears of 60 teeth or less, with which they are commonly engaged, I believed the interference would not be noticeable in practice. I was strongly tempted to go further and fix upon

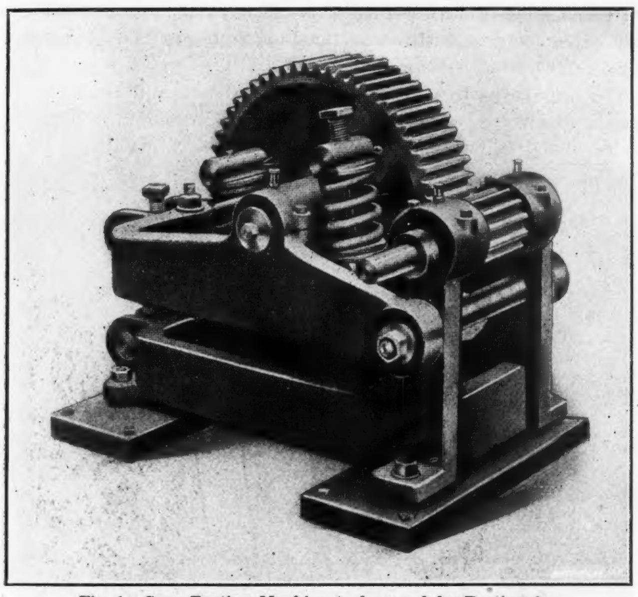


Fig. 1. Gear Testing Machine to be used for Testing for Noise and Durability

an obliquity of 22½ degrees, but 20 degrees then appeared such a radical departure from common usage that the advantages of the greater angle were dismissed as being possibly more theoretical than real.

The 20-degree system with an addendum of 0.3-pitch has now been in use by Wm. Sellers & Co. for twenty-five years and has given satisfaction in a general way, although the interference referred to has been more or less noticeable on 12-toothed pinions. I reviewed this matter ten years ago in a paper read before the Engineers' Club of Philadelphia, advocating an obliquity of 22½ degrees, and suggested as a much-needed reform in engineering practice the consideration of uniformity in interchangeable gearing. I then pointed to the action of the Franklin Institute more than thirty years earlier, which inaugurated a standard system of screw threads, and expressed the hope that by the interchange of opinions an agreement among engineers might be reached leading to the gradual disappearance of needless diversity in the forms of gear teeth.

Nothing in this direction had been done, however, when the subject of interchangeable involute gear-tooth systems was brought to the attention of the American Society of Mechanical Engineers in a paper by Mr. Ralph E. Flanders, presented in December, 1908.* A number of systems in general use were analyzed and their merits discussed from various points of view and the desire expressed that the council of the society be petitioned to appoint a committee to investigate the subject of interchangeable involute gearing and, if found desirable, to recommend a standard or standards.

In answer to this petition the council voted in January, 1909, that the president appoint a committee of five members† to formulate standards for involute gears and present the

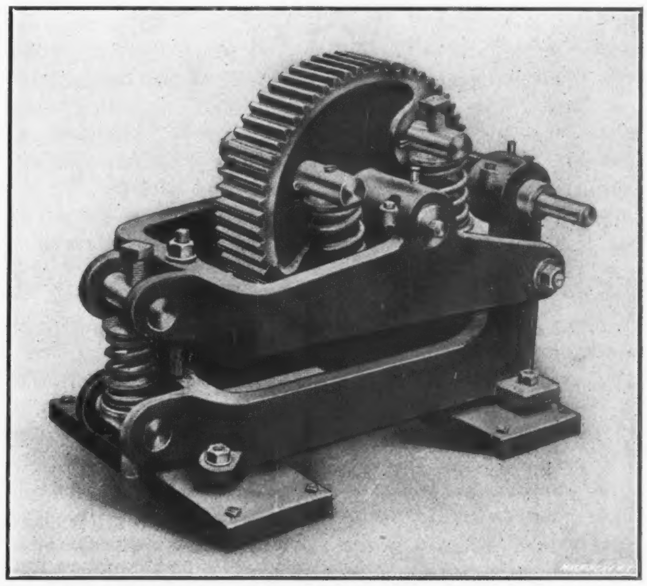


Fig. 2. View of Gear Testing Machine showing Pivoted Frame and Spring for Measuring Thrust

same to the council. Without anticipating in any way the conclusions of this committee yet to be formulated, if indeed an agreement be possible, I believe it will be helpful to give publicity to the line of investigation upon which we have embarked and thus obtain the benefit of such criticism or encouragement as it may provoke.

As pointed out in Mr. Flanders' paper and as mentioned

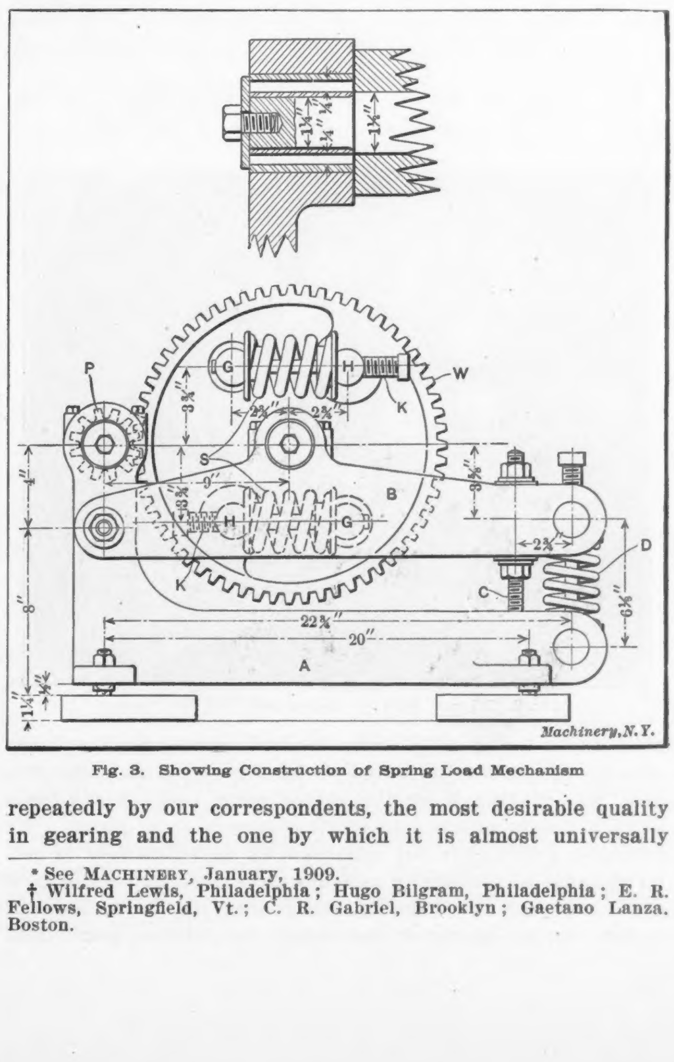


Fig. 3. Showing Construction of Spring Load Mechanism

repeatedly by our correspondents, the most desirable quality in gearing and the one by which it is almost universally

* Abstract of paper presented at joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, July 26-29, 1910.

This paper was prepared at the request of the meetings committee of the A. S. M. E. as a contribution by Mr. Lewis, and is not to be considered as an expression of the opinions of the other members of the committee.—EDITOR.

* See MACHINERY, January, 1909.

† Wilfred Lewis, Philadelphia; Hugo Bilgram, Philadelphia; E. R. Fellows, Springfield, Vt.; C. R. Gabriel, Brooklyn; Gaetano Lanza, Boston.

judged, is quietness and smoothness of running. Next to this comes strength, durability and permanence of form, and upon the last, of course, depend continued quietness and smoothness of action. Friction and journal pressure are of less importance, but still worth considering, and before reaching any conclusions from theoretical considerations alone, we propose to determine if possible, in a practical way, the relative advantages of some of the systems in common use and, with these, other systems to which we are disposed to give favorable consideration.

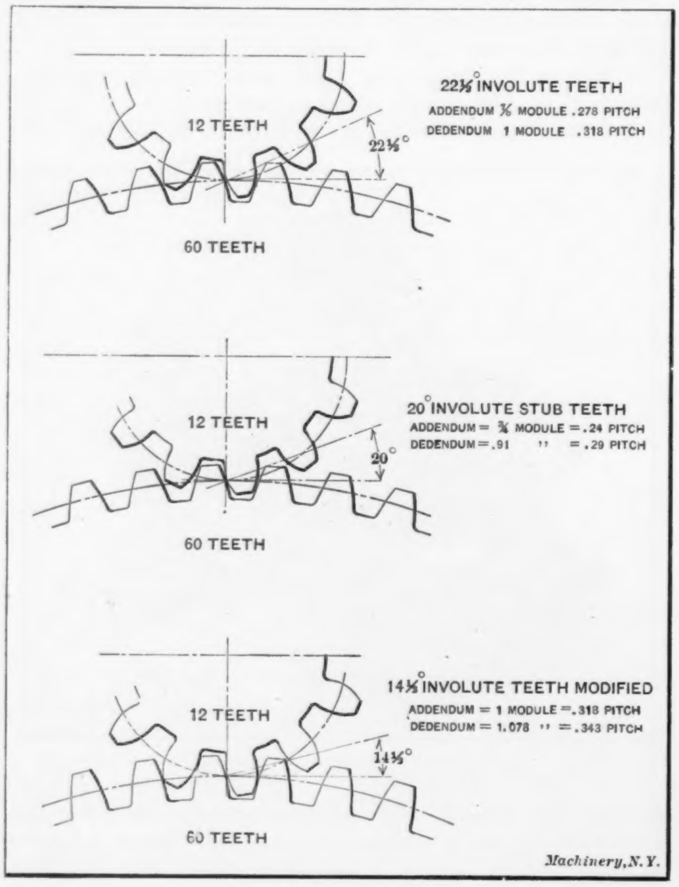


Fig. 4. Gear Types to be tested

Prof. Webb, of Stevens Institute of Technology, has suggested the possibility of so dividing one of the pair of spur gears to be tested as to make the load on the teeth self-contained. The apparatus which we have designed embodies this idea, thus making it possible to run gears under heavy loads at high speeds with a very small consumption of power. We have also provided in our apparatus for an adjustment of center distance and means to measure the thrust between centers while the gears are running. Of course, the thrust between centers can be estimated very closely for involute gears from the pressure angle on the teeth, but we anticipate results somewhat in excess of this on account of the excess in friction of approach over that of recess, and, if any but involute gears are tested, it will also be interesting to compute from experimental data the effective obliquities of other systems.

Fig. 5. Bilgram System: Pinion with Undercut Teeth

We propose to determine the friction loss under various speeds and pressures for wheels and pinions cut to the Brown & Sharpe 14½-degree standard, the 20-degree stub tooth and a 22½-degree tooth with addendum of ⅞ module or about 0.278 pitch. These gears will be tested at normal center distance, and also at distances about 1 per cent or 2 per cent of the pitch greater or less than this, and an effort will be made to record graphically the noise produced under these different conditions.

We believe that accuracy and permanence of form can thus be given their proper influence on the reduction of noise. It may take some time to determine the effect of wear, but from the method of loading the teeth and the small amount of power consumed, some indication of the tendency of wear can be obtained. All gears tend to wear out of shape, and involute gears more so than cycloidal, but we recognize as a possibility that this tendency may be checked by the deformation itself and also that the loss in friction at different parts of a gear tooth is practically incalculable on account of the variations in friction for different velocities of sliding. The experiments we propose should therefore give information unobtainable in any other way and throw a flood of light on the problem in hand.

The apparatus to be used by Messrs. Green and Doble, of the Massachusetts Institute of Technology, in making these experiments is shown by the half-tones, Fig. 1 and Fig. 2, and the line drawing, Fig. 3, which gives some of the principal dimensions and shows the knife-edges on which the machine rests. The machine consists of a frame A designed to carry a pinion shaft in roller bearings at one end, and a frame B pivoted to it and designed to carry the gear wheels W engaging with a wide-faced pinion P on the pinion shaft. The frame B is held to the frame A at its outer end by an adjustable clamping bolt C, and provision is made to measure the thrust on centers by means of the spring D acting between the frame A and an adjustable abutment on the frame B. The gear wheels to be tested consist of a central gear with a wide face and two side gears with narrow faces. The central gear carries two heavy cross pins G, which pass through clearance holes in the side gears, and the side gears carry two heavy pins H, which pass through clearance holes in the central gear. Between the projecting ends of these pins G and H, heavy helical springs S are inserted, upon which pressure can be applied by means of the set-screws K.

Fig. 6. Bilgram System: Pinions with Increased Addenda in Mesh with Gear

The pressure of these four springs S is resisted by the gear teeth, the middle gear pressing against one side of the pinion teeth and the side gears pressing against the other side. The pinion thus becomes simultaneously a driver and a driven gear and the power required to turn it when loaded in this

way is only that required to overcome the friction of the teeth and whatever resistance there may be in the gear journals. The latter presumably is very small indeed, but provision has been made to measure it by substituting plain cylinders without teeth for the gears and pinion, and running these under the same journal pressures. By deducting the resistance due to journals from the total resistance with running gears, the friction of the teeth alone can be determined.

In operation this machine is driven by an extension to the pinion shaft, carried to bearings several feet distant to permit of ample flexibility. The knife-edge directly beneath the pinion rests upon a permanent support, and the other knife-edge is carried upon the platform of a small platform scales. The driving moment in the pinion shaft will therefore be measured by the scale reading at the end of an arm 20 inches long, and by reversing the direction of motion given to the pinion shaft the effect of any initial lateral strain in the driving shaft can be eliminated.

Fig. 4 illustrates three types of gearing to be tested, and, with these, other types may be included later on.

Figs. 5, 6 and 7 illustrate a group of involute gears designed by Mr. Bilgram to engage a rack of 15-degree obliquity, and to demonstrate the possibility of using pinions of ten or even nine teeth with such a rack, provided the addendum can be varied. Without wishing to advocate the use of a variable addendum in interchangeable gearing, it is interesting to note the possibility of making a tentative solution of the problem in this way. A set of these gears has kindly been furnished

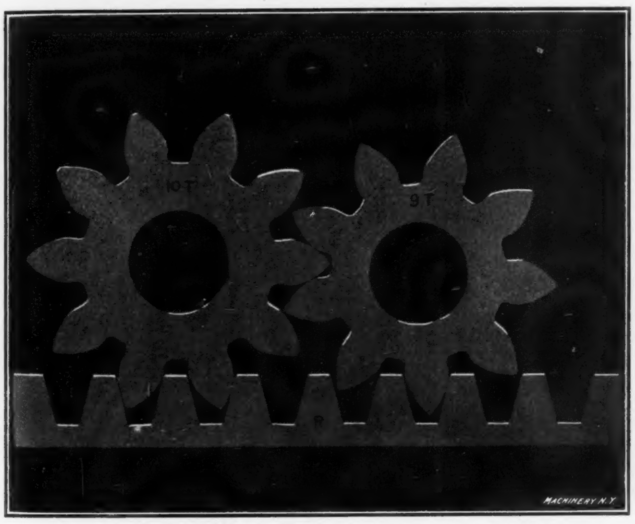


Fig. 7. Bilgram System: Pinions with Increased Addenda in Mesh with Rack

by Mr. Bilgram for making a comparative test. He has also made a set of models from which the figures have been photographed, and, referring to them, he gives the following explanation:

"While the involute system of gearing has decided advantages over any other, it has the one disadvantage that the faces of the teeth of wheels come into interference with the flanks of pinions, if the latter have a comparatively small number of teeth. Unless the flanks of the latter are undercut, the teeth will interlock or at least mesh improperly.

"In making a single pair of wheels, a remedy can readily be applied. There are two ways in which interference can be avoided, namely, either by increasing the angle of pressure or by shortening the addendum of the wheel. If the latter method is chosen and it is desired not to reduce the working depth of the teeth, it is necessary to add to the addendum of the pinion the amount taken from the addendum of the wheel.

"This latter method is out of the question when the problem is given to make an interchangeable set of spur wheels from a rack down to a 12-tooth pinion. This problem may be solved by a combination of both remedies alluded to."

The method consists of making racks and larger wheels with normal addendum, but increasing the addendum of pinions just enough to prevent the rack tooth from interfering with the flank. The samples presented (Figs. 5 to 7) consist of a 36-toothed wheel *W* or a rack *R* with angle of pressure of 15 degrees and addendum equal to the modulus. The 12-tooth pinion *A*, generated by a rack corresponding to rack *R*, shows the undercutting thereby produced. Obviously this pinion will not work, as so much of the involute is cut away that the path of contact is materially less than one pitch. But there are also shown pinions of twelve, ten and nine teeth, made with increased addenda. These were generated by a rack like *R*, but with a somewhat greater addendum than that used in generating the wheel *W* and a somewhat greater cutting depth. If these pinions are then mated with wheels of a large number of teeth, they will not enter as far as with pinions of an equal number of teeth, thus having a slightly less working depth.

On this plan may be based a system of involute gearing with a working depth of twice the modulus, and with a moderate pressure angle, 15 degrees in the samples submitted. Pinions of a small number of teeth will have an increased addendum, but a theoretically correct action is maintained. The pinion teeth have a wide base and are strong. One disadvantage in those cases in which pinions with less than about 24 teeth are embraced, is that the center distance is greater than that computed by the usual rule from the modulus and the number of teeth of the meshing wheels. Moreover, pinions will not have the full working depth when meshing with large wheels or with racks, but even in the case of a 10-tooth pinion meshing with a rack, the path of contact exceeds one pitch so that at least for a portion of the action two teeth will be in contact simultaneously.

The plan proposed by Mr. Fellows is to use an involute with an angle of pressure of 20 degrees and to reduce the addendum to ¾ of the modulus. Such teeth are known as "stub teeth." By this method interference in case of a rack gearing with a 12-tooth pinion is just avoided and in the case of two 12-tooth pinions meshing with each other the path of contact is equal to about 1⅛ of the pitch. Mr. Gabriel prefers the 14½-degree standard of the Brown & Sharpe Mfg. Co. The system which I propose is that of a pressure angle of 22½ degrees and an addendum of ⅞ of the modulus.

I believe that an interchangeable system of involute gearing, to be of the greatest value, should extend from a 12-tooth pinion to a rack, and in the selection of gears to be tested we have chosen a 12-tooth pinion engaging a 60-tooth wheel. The maximum reduction with the maximum strength in a limited space is the problem in gearing that generally confronts the engineer and a ratio of five to one is very often as much as he can realize without sacrificing too much strength. I recognize, of course, that the adoption of a larger number of teeth in the smallest allowable pinion overcomes some difficulties, and that this may be a debatable point, but I do not think any system of interchangeable gearing will be satisfactory which does not include pinions of twelve teeth.

* * *

VOLUME OF SALES IN THE ELECTRICAL INDUSTRY

The *Wall Street Journal* estimates the gross sales of the five largest electrical companies for 1910, as follows:

General Electric	$70,000,000
Western Electric	61,000,000
Allgemeine Elektricitäts Gesellschaft	55,000,000
Siemens & Halske	50,000,000
Westinghouse	30,000,000

The following table, which gives the gross sales of the three largest American companies for the last five years, brings out their relative positions in the electrical industry:

	General Electric	Western Electric	Westinghouse
1909	$52,000,000	$46,000,000	$29,000,000
1908	44,000,000	32,000,000	21,000,000
1907	71,000,000	53,000,000	22,000,000
1906	60,000,000	69,000,000	33,000,000
1905	43,000,000	44,000,000	24,000,000
Total	$270,000,000	$244,000,000	$129,000,000

* * *

It is stated that the Western Electric Co., Hawthorne, Ill., uses, in a single year, about one ton of platinum in the manufacture of telephone apparatus. Platinum costs 30 per cent more than pure gold.

MAKING AUTOMOBILE RADIATORS

By ETHAN VIALL*

There are a great number of forms and types of radiators of the kind used for cooling the water in automobile and air-ship engines, and while this article will give in detail the manufacturing steps necessary in the building of radiators of the perforated fin-and-tube type, reference will merely be made to the various shapes and forms of this type.

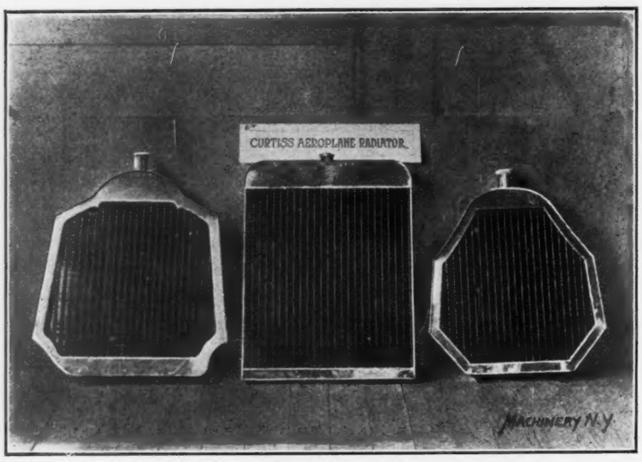


Fig. 1. Three Forms of Radiators of the Same Type. The Middle one is a Duplicate of the ones used on the Curtiss Aeroplanes

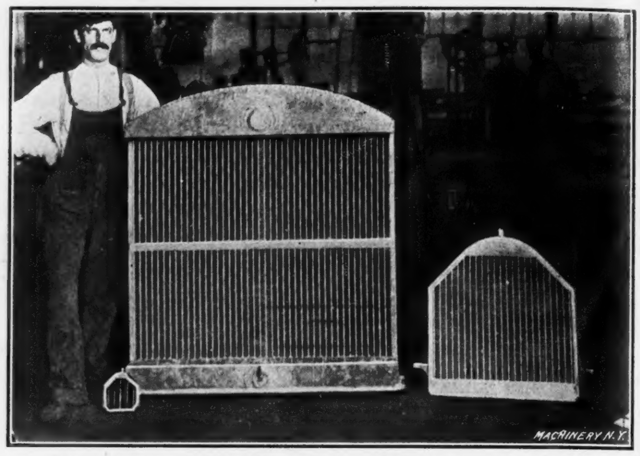


Fig. 2. Extremes in Radiator Sizes: a Model, a Traction Engine Radiator and an Automobile Radiator

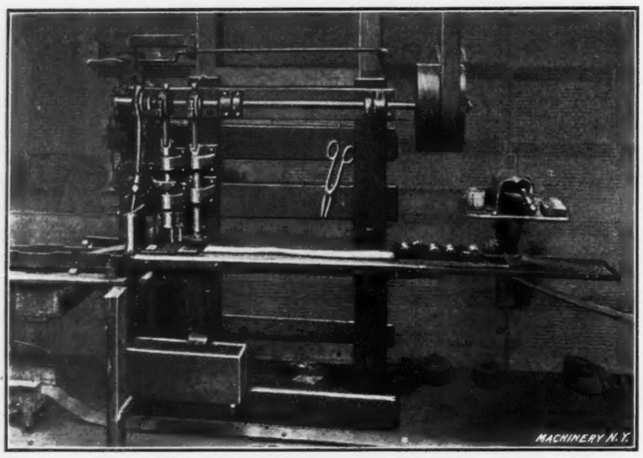


Fig. 3. Special Automatic Machine for Edging, Punching and Shearing off the Fins

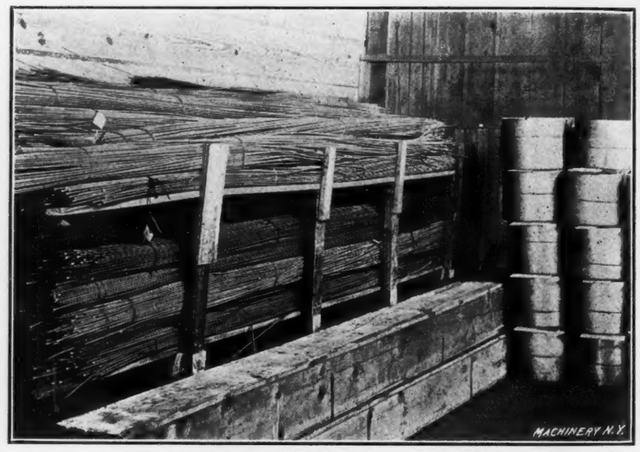


Fig. 4. Bundles of Tubing used in Radiator Construction

In order that the reader may have a clear idea of the type of radiator that is under discussion, three forms are shown in Fig. 1. These radiators are manufactured by the Detroit Radiator Co., Detroit, Michigan, which has a capacity of 200 radiators a day, and it is through the courtesy of Mr. C. F. Patterson and Mr. R. L. Frost, and the personal assistance of Mr. Beardsley, that the accompanying photographs were obtained. Fig. 2 shows the range of sizes that are turned out, the radiator on the right being a regular automobile radiator, the middle one a special radiator for a traction motor, and the tiny one at the man's feet, a model.

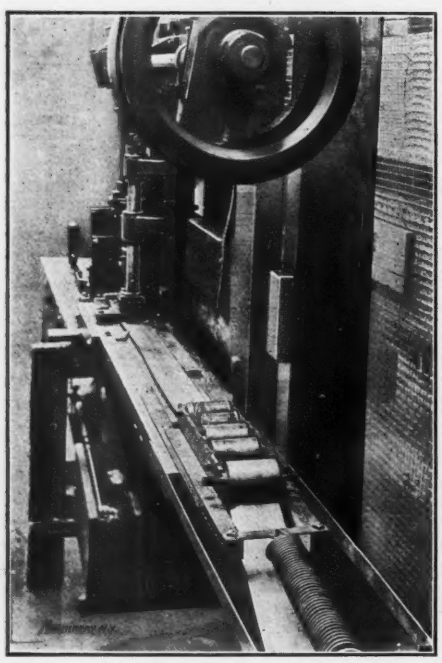


Fig. 5. Edge Turning Rolls used on the Automatic Machine for Edging the Fin Strips

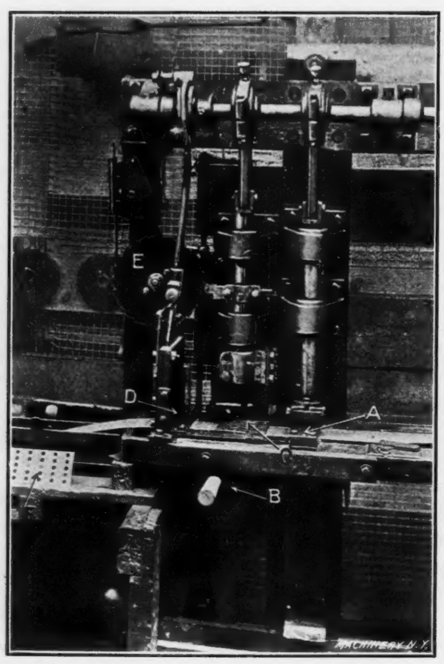


Fig. 6. The Perforating, Feeding and Shearing Mechanism of the Automatic Machine

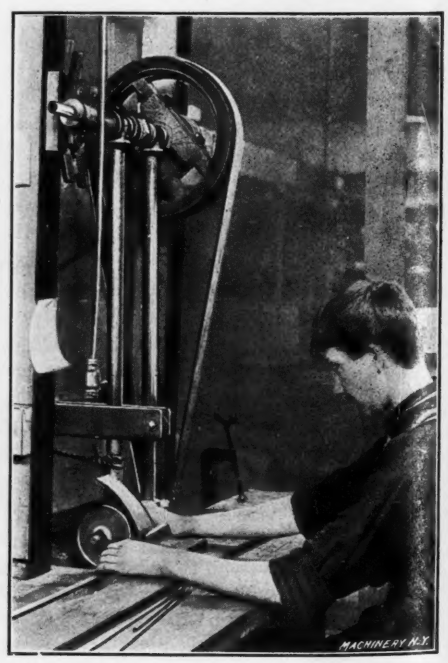


Fig. 7. Sawing the Tubing to Specified Lengths with a Small Saw

As can be seen from the half-tones just referred to, the cooling surface of the radiators consists of thin perforated strips of copper or brass through which are thrust small tubes carrying

* Associate Editor of MACHINERY.

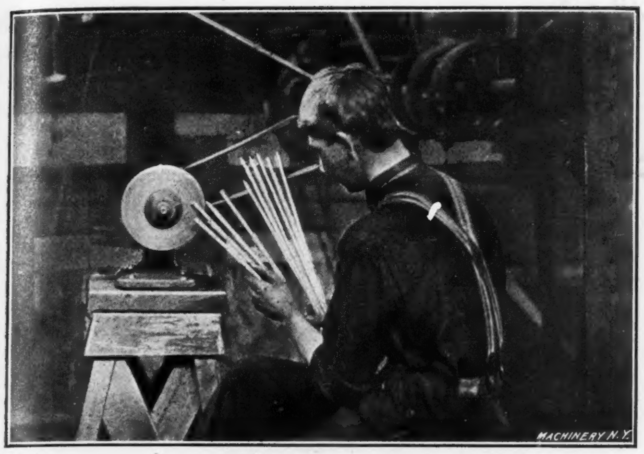


Fig. 8. Beveling the Ends of the Tubes


Fig. 9. Tinning the Tubes

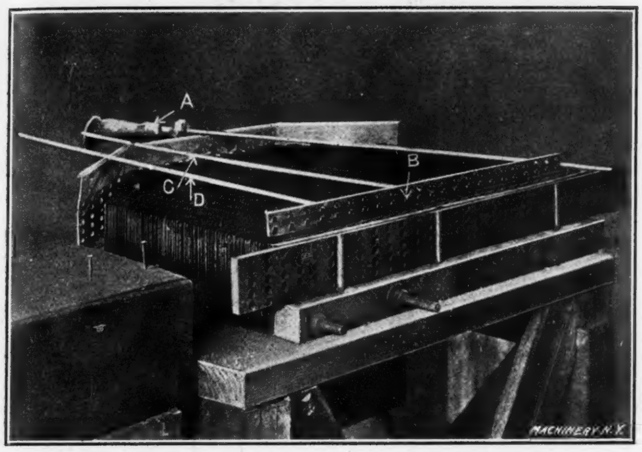


Fig. 10. The "Nests" used while putting the Tubes into the Fins


Fig. 11. Soldering on the Ends

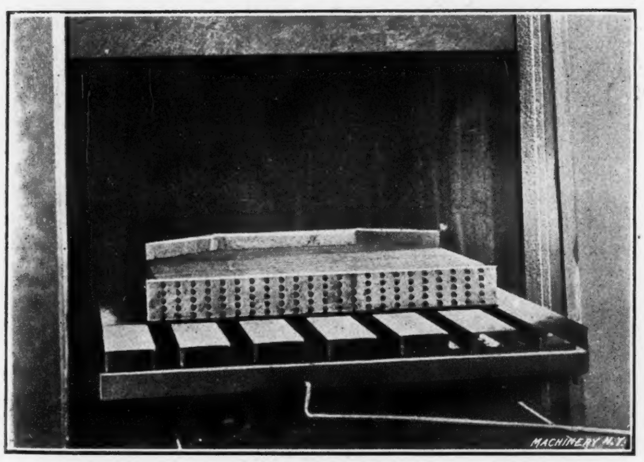


Fig. 12. Fusing the Solder-covered Tubes with the Fins


Fig. 13. Fitting and Soldering on the Water Tanks

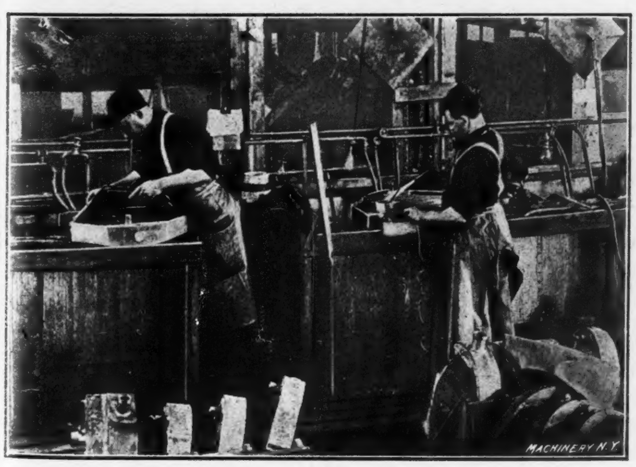


Fig. 14. Testing, and Soldering the Leaks

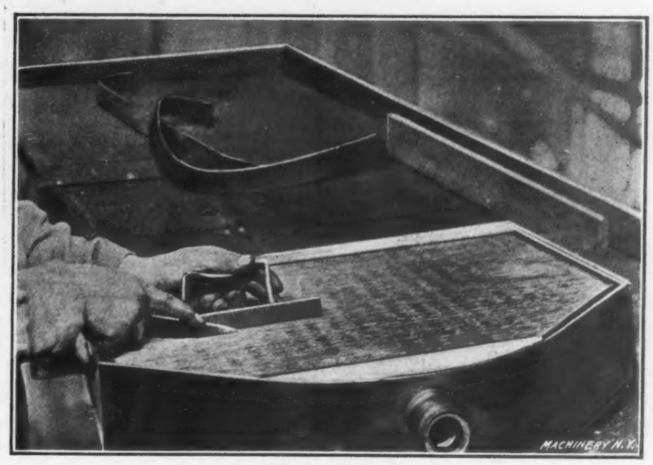


Fig. 15. Straightening the Fins

the water, these tubes being connected to tanks at both ends.

Edging, Punching and Shearing the Fins

The cooling strips, or fins, as they are called, are made by running a band of brass through a specially built automatic

Fig. 16. Lining up the Fins by Melting the Solder with a Gas Blow-torch

machine which doubles over each edge of the band, punches the holes for the water tubes, and cuts the strips into the required lengths. A general view of the machine is given in

Fig. 18. Wiping the Surplus Paint off the Frame

Fig. 3, and in Fig. 5 the mechanism used to double over the edges is shown. As the engraving shows, the turning device consists of a box or forming die into which is set a series of rolls, the first roll being straight. The second roll has ends beveled to 45 degrees, and presses the strip down

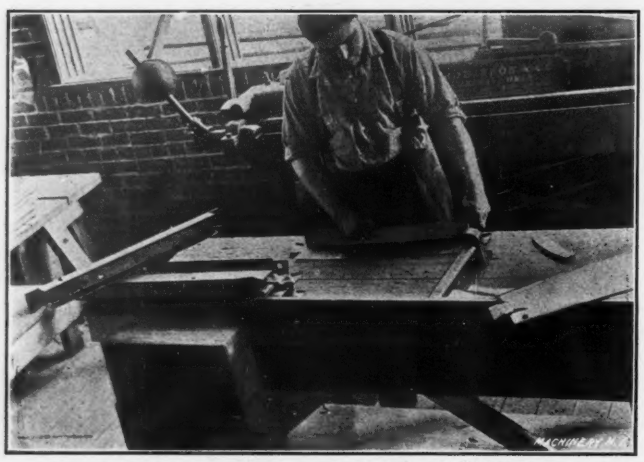


Fig. 20. Making the Bottom Water Tanks out of Sheet Brass

into the die channel, bending the edges of the strip to correspond to the bevel on the ends of the roll. The third roll is straight, but short enough to bring the edges of the strip up square. The fourth roll is like a common thread spool, with beveled flanges on each end which roll the edges inward 45 degrees, while the last roll flattens them down onto the body of the strip. The perforating, feeding and cutting-off mechanism is shown in Fig. 6. After the strip passes under the battery of punches *A*, it is drawn along by the feed wheel *B* which has pins in its periphery to engage the holes punched in the strip, the strip being held to the rim of the feed-

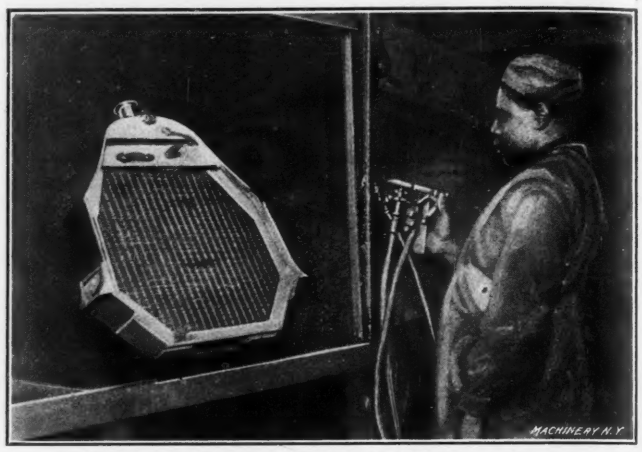


Fig. 17. Spraying the Paint over the Fins and Tubes

wheel by the spring-fingers *C*. As the required length is fed out, it is cut off by the shear *D*, which is tripped by the action of the ratchet wheel *E*. Various lengths may be sheared

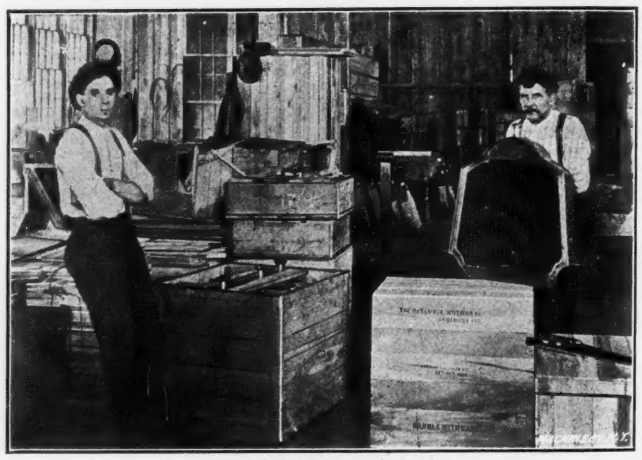


Fig. 19. Packing and Shipping

off by using different sized ratchet wheels. A section of one of the punched fins is shown at *F*.

Preparing the Tubes

Both seamless and hard soldered brass or copper tubing

Fig. 21. Scraping the Soldered Joints of a Made-up Frame

is used in the radiators, the tubing coming in long bundles as shown in Fig. 4. Whether copper or brass, seamless or soldered tubing is used depends on the specifications and price of the order. The tubing is cut to the specified length by using a small saw as shown in Fig. 7. Tubing cut to standard lengths for regular orders is kept in stock racks.

After being sawed into lengths, the ends of the tubes are slightly beveled on an emery wheel, Fig. 8, and they are then taken to the tinning room and coated with "half and half" solder. The tinning process, which is illustrated in Fig. 9, consists of grasping the tube with a pair of Y-nosed pliers, dipping it into the acid bath *A* and then into the bath of molten solder *B*, after which it is placed on end to cool as at *C*. Care is taken to dip the tubes into both baths by placing one end in first and then slowly immersing, so that the liquid flows entirely through the tube, driving the air out ahead of it; otherwise the tinning solution would be apt to spatter dangerously as the imprisoned air or surplus acid suddenly expanded.

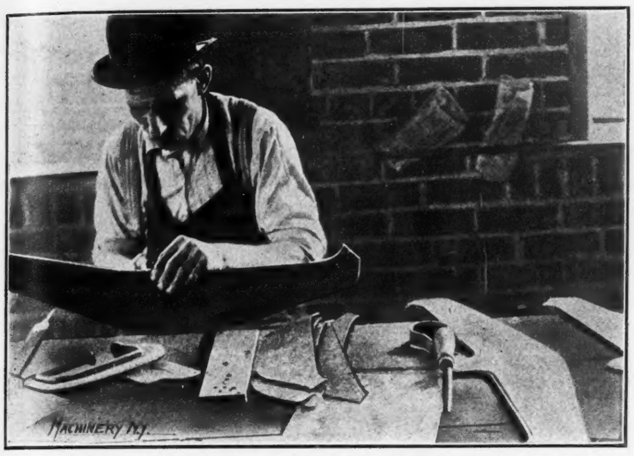


Fig. 22. Filing Frame Parts that have been cut out by Hand from a Templet

Assembling the Fins and Tubes

The fins and tubes are assembled in "nests," Fig. 10, which are made up of heavy combs of iron solidly bolted together and so spaced that the fins may be placed between them, the holes in the fins coinciding with the spaces between the teeth of the combs. A tube is placed on the rod *A*, provided with a handle and forced in between the comb teeth, through the holes in the set of fins. In the engraving, *B* is a fin which has been dropped about half way down between a set of teeth. A number of nests are in use for the various sizes and shapes of radiators; these are so shaped that a top and bottom piece may be properly placed in relation to the fins. After the tubes are all in, the radiator is removed from the nest and the top and bottom soldered on by hand, as in Fig. 11, after which it is dipped in acid and placed in an oven, Fig. 12, and heated just enough to cause the solder on the tubes to run and fuse onto the fins, making the radiator practically one solid mass. Next, the top and bottom water tanks are fitted and soldered on, Fig. 13, and the side strips put into place, the radiators being then tested by air pressure in a tank of water. Fig. 14 shows the testers at the water tanks, soldering up leaks with a blow torch.

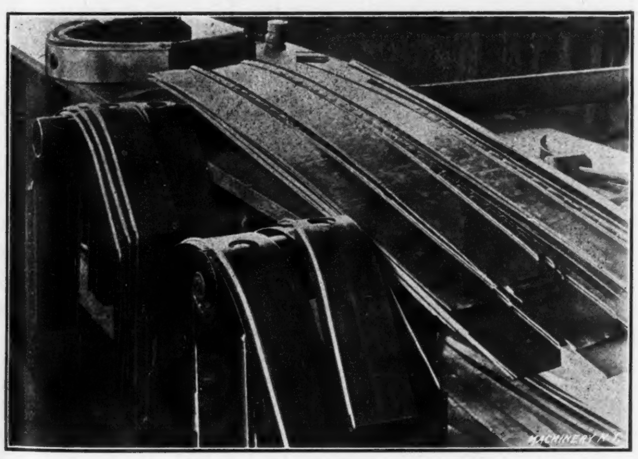


Fig. 23. Beaded and Bent Frame Parts

The fins are now straightened and lined up as shown in Fig. 15, and if they are much out of line they are corrected by melting the solder with a torch and straightening, as shown in Fig. 16. The radiators are again tested for leaks and the tanks and frame polished, after which they are ready to be painted, which is done by spraying the fins and tubes with a special air drying enamel, Fig. 17. Then the surplus paint is wiped off the polished surfaces as shown in Fig. 18, and the completed radiator is ready to be packed and shipped, the method of crating or packing being shown in Fig. 19.

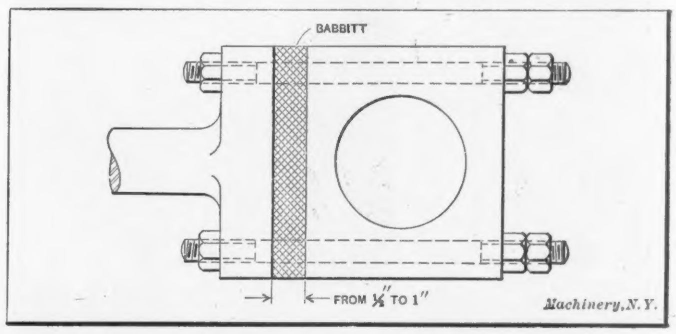
The work on the tanks and frames of the radiators is essentially tinshop work, as many of the radiators are made to order and then, too, the size and shape of most of the parts preclude the use of press work unless when required in quantities. However, a few of the parts are made in a punch press, including the top water tank shell, though the bottom tank is sheared out by hand from an outline scribed from a templet, and then bent to shape as shown in Fig. 20. Irregular frames are made up of a number of parts soldered together and scraped smooth at the joints as shown in Fig. 21. Fig. 22 shows a man smoothing up, with a file, sheet brass frame parts, which have been cut out by hand from a templet, while in Fig. 23 are shown a number of beaded strips, some of which have been bent to shape over a form.

* * *

METHODS OF INCREASING EFFICIENCY OF GASOLINE ENGINES AT HIGH ALTITUDES

By STANLEY GOULD*

Any one familiar with gasoline engines knows that an engine which runs well at sea level seems to lose its efficiency when it is operated at a high altitude, say, of from 6000 to 7000 feet above sea level. When an engine is taken to this altitude, it is noticed that the sharp ring in the cylinder which occurs at the time of ignition is not present, or is not nearly so prominent as it is at a lower level. The explosion is weak and the engine lacks power. The reason for this is that the air is so rarified that the mixture is not compressed enough before ignition. This effect is often overcome by fastening a plate slightly smaller than the bore of the cylinder on the top end of the piston. This, as can be seen, reduces the compression space and thereby gives a higher compression. There is one objection to this method, however, which is due to the fact that the plate gets hot and there is apt to be premature ignition.



Method of increasing Length of Connecting-rod to decrease Compression Space, and thus increase Efficiency of Gasoline Engines at High Altitudes

The same results may be obtained with less trouble and expense and also with greater efficiency, by separating the crank-pin brasses from the connecting-rod the desired amount to increase the compression, and filling the space with babbitt, as shown in the accompanying illustration. The babbitt is generally made from 1/2 inch to 1 inch in thickness, depending on the design of the engine, altitude, etc. A little experimenting is usually necessary to determine exactly the amount required, and longer connecting-rod bolts may also have to be made. Care should be taken that the rings on the piston do not pass beyond the counterbore in the cylinder. This method may be easily accomplished, and it will generally be found a means for getting considerably more power. However, it cannot be expected that an engine will give as much power in a high altitude as it will at sea level, as the power depends on the amount of air and fuel taken into the cylinder. The main point is to get the proper compression for the mixture, which should be as high as possible without causing pounding or premature ignition.

* Address: 3221 N. Griffin Ave., Los Angeles, Cal.

THE OPERATION AND MANUFACTURE OF MAGNETOS—1

By HAROLD WHITING SLAUSON*

Ever since the first internal combustion motor puffed and snorted and backfired, the ignition problem has been one of the most serious with which the designers have had to contend. In the early days the "hot tube" served as the source of heat by which the charge was "explōded," but this was adaptable only for low-speed, heavy-duty, inefficient, stationary engines, and was no more suited for automobile or motor boat practice than is flint and steel for a modern rapid-fire gun. The electric current has gradually been developed as the source of heat for ignition purposes, until now it may be said to be used on practically every internal combustion engine in existence. Its points of advantage over any of the other systems formerly in use lie in the fact that it furnishes a point or area of intense heat at the instant desired, and that the time during the stroke of the piston at which the ignition shall occur can be regulated by the operator. This makes it the only ignition source possible for use on high-speed motors.

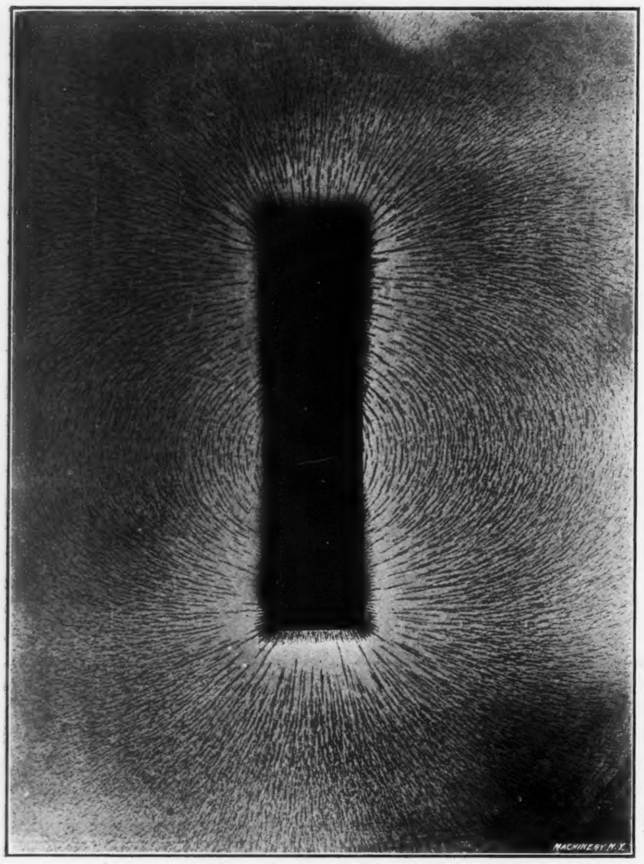


Fig. 1. Iron Filings showing the Lines of Force around a Bar Magnet

Dry Batteries vs. Magneto Generator

It is only recently, however, that the electrical system of ignition has been brought to its present high efficiency, for the source of current has not always been as reliable as could be wished. Dry batteries depend upon a chemical action for the production of current, and they will deteriorate whether used or not. This renders continual testing necessary to make certain that the batteries are sufficiently strong for the day's run, and at best they are more or less capricious and liable to fail without previous warning. A storage battery will continue to give current until it has "run out," but it must be charged occasionally and its ingredients and plates must be attended to carefully, especially during freezing weather, so that it will not deteriorate rapidly or be utterly ruined. Consequently, although dry batteries or storage batteries form reliable sources of current while they last, the care, attention and renewals that they require if used frequently, make them more suitable as auxiliaries than as generators or storehouses of the main ignition supply.

Universal Application of Magneto Generator on Automobiles

During the last few years, the increase in the reliability of the automobile motor has been astonishing. From a machine which, a decade ago, could only be driven by an expert, to a car that can be handled by a woman or child, that will start on the first crank, and that will continue to run indefinitely, day and night, as long as it is fed with gasoline and oil, is a striking advance, but it would not be exaggerating to say that much of this change has been brought about by the almost universal application of the magneto on the modern automobile. The magneto generates current independent of storage capacity or chemical renewals, and consequently furnishes a source of ignition supply as long as power can be obtained with which to drive it. It is really a converter, or transformer of mechanical force into electrical energy, and as the small amount of power necessary to operate it is obtained from the motor to which it is furnishing current, it will generate the ignition supply without deterioration as long as required.

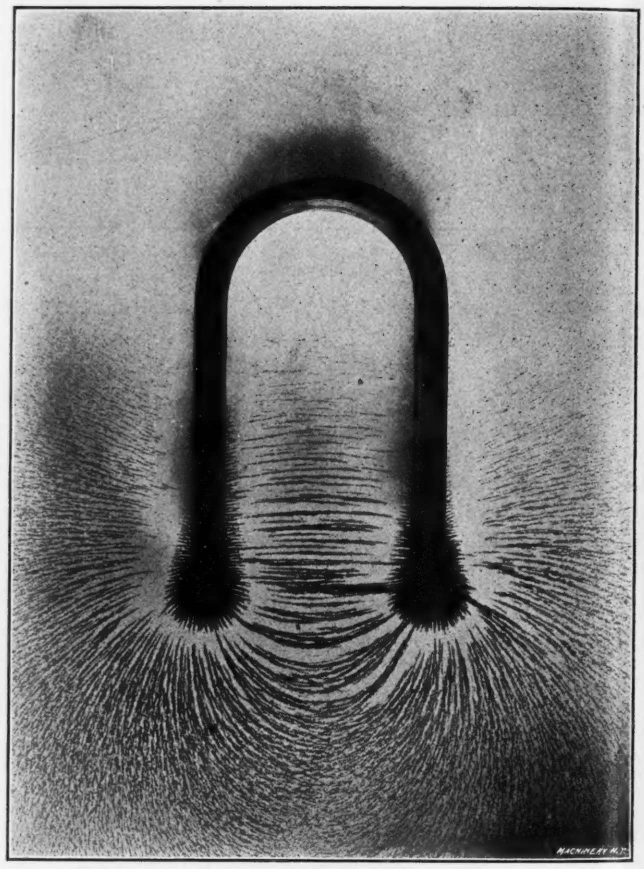


Fig. 2. Showing Lines of Force around the Poles of a U-shaped Magnet

The Principle of the Magneto Generator

Although the appearance of the magneto is familiar to everyone who has ever driven a car or who has been interested in internal combustion motors in general, probably but a small percentage of these persons really understand the theory of the action and operation of the machine. It is in reality nothing but a small and compact form of dynamo with a few changes and refinements made necessary by the nature of its location and the work that it is called upon to perform. Around every magnet there are what are known as "lines of force" emanating from all portions, and concentrated chiefly at the extreme ends, or north and south poles of the magnet. The basic principle of the magneto, dynamo or generator, lies in the fact that if these lines of force are cut by a wire passing near the magnet at either the north or south poles, an electromotive force, or difference in pressure of an electric current, will be set up in this moving wire. In other words, a current of electricity is generated in this wire cutting the lines of force, and if the ends of this wire are connected, a flow of the electric "fluid" will continue as long as the

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* Address: Bath Beach Station, Brooklyn, N. Y.
Figs. 1 to 5 inclusive from *Motor*. Copyrighted by the New Publication Co., New York.

motion through the lines of force is kept up. If the magnet is bent U-shape, a moving wire, or series of wires, may cut the lines of force emanating from both poles without moving out of a position of rotation midway between the two poles. The magnet is known as the field of the machine, and the wire cutting the lines of force forms the armature—the two composing the principal parts of any electric generator or motor.

The armature generally consists of an iron spindle, notched out in several portions of its periphery, and rotating on a horizontal axis placed midway between the two poles of the

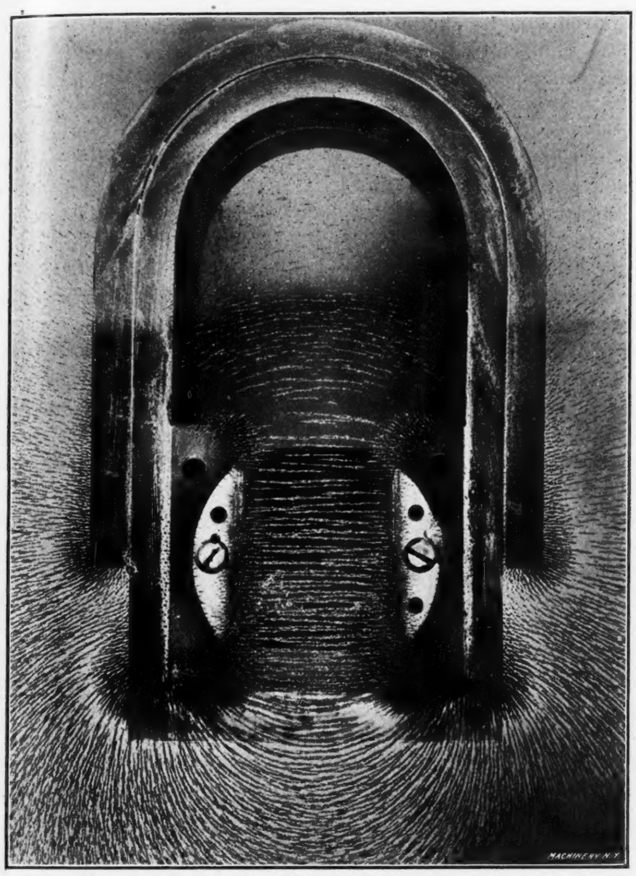


Fig. 3. Compound U-shaped Magnet with Pole Pieces and Armature showing Action of Lines of Force

magnet, or field. Through these notches in the armature and parallel to the axis, are wound several layers of insulated wire. This great number of wires cutting the lines of force of the field, serve to generate a greater current than would be the case were but one wire used, and consequently if the armature is driven at a high speed, and the magnetic fields are strong enough, electric power sufficient to light several lamps may be obtained from even the smallest machine. In the ordinary power-house generator, the fields are wound with insulated wire in order to form a separately-excited electromagnet. It is in this respect that the magneto differs chiefly from the dynamo, for the former has no *electro-magnet*, but uses instead, a permanent magnet. This consists of the U-shaped bar of iron, specially treated so that it will retain its magnetism for an indefinite period of time after it has once been magnetized.

Although the lines of force are, of course, invisible, their position and the effect made upon them by a rotating armature or series of wires cutting them transversely are well shown by the accompanying illustrations, Figs. 1 to 5, inclusive, which show iron filings in the field of a magneto. These illustrations were taken when the armature was placed in different positions, and show unusually well how the lines of force are collected or swept up, by the revolving bundle of wires, and unite to form the electric current.

Lines of force from the north pole of a magnet cut by a wire or revolving armature will induce a current in one direction through the circuit, while the current flows in the opposite direction if the lines of force from the south pole are cut. This means, then, that in the simplest form of magneto or dynamo in which the two ends of the armature wire are led to "collector rings," the current will flow first in one direction, and then in the other, as alternate poles of the field are cut by the revolving armature. This forms the alternating current, familiar to most people. Practically all magnetos that are geared to the motor are of the type producing alternating current.

Principle of the Direct-current Magneto

In equipping old automobile motors and marine and stationary engines with magnetos, however, it is sometimes impracticable to install a set of gears, and in this event the use of a direct-current magneto is advisable. The direct-current machine is the opposite of the alternating type in that any point in the circuit always has a north and south pole. In other words, the direction of the flow of current is constant, and not changeable, as it is in the alternating type. In order to keep the current flowing in the same direction, a slightly different type of armature must be used in the direct-current type than is found in the alternating machine. Such an armature generally has several slots cut in its periphery, parallel to the axis of rotation, and in each pair of these slots, on opposite sides of the armature, are wound a few turns of insulated wire. A copper commutator or drum, is placed on the armature shaft near the terminals of these turns of wire. This commutator has as many segments on its surface as there are slots in the periphery of the armature, and each bundle of wires is soldered to its own segment, which is thoroughly insulated from all the rest. Two copper or carbon brushes are placed 180 degrees apart in contact with the armature, and continually wipe against it as the armature revolves. As each bundle of wires passes by one pole of the field it induces a current which flows in one direction, and this is collected by the brush on that side and sent out into the circuit. By the time this same section of the armature reaches the

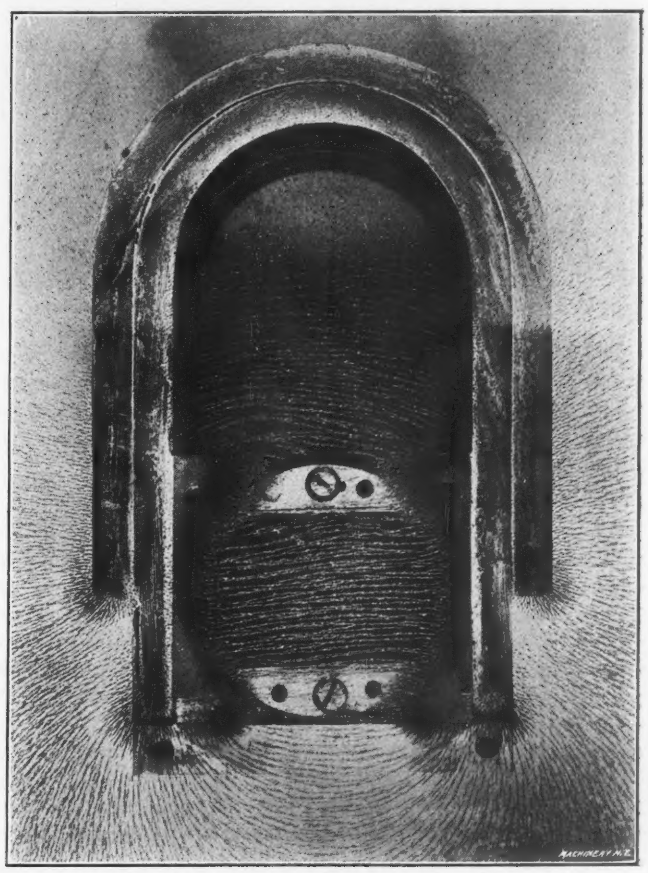


Fig. 4. Same as Fig. 3, Armature rotated One-fourth Turn. Note Change in Lines of Force

other pole of the field and is excited with a current in the reverse direction, its segment of the commutator wipes against the opposite brush and the electricity thus collected flows through the circuit. In other words, one brush collects all the current when the windings of the armature are positively excited by reason of proximity to one pole, and the opposite brush collects all the negative current from the armature when it is cutting the lines of force of the other end of the magnet.

The Function of the Distributor

Although the field and armature are the primary parts of an electric generator, there are several other attachments to a magneto which are vitally necessary for the successful application of the machine to an automobile ignition system. One of these is the distributor, which is the hard rubber box, generally located on top of the magneto, from which the wires that lead to the separate cylinders of the car emerge. By means of a hard rubber disk, in the periphery of which is a copper segment connected with the source of current supply, connection is made with the spark plugs of the various cylinders in the proper order. This distributor enables a single-unit coil to take the place of the four coils usually found on the dash of all cars using a battery ignition system. In some systems, to be considered later, no coil whatsoever is used, the current being led directly from the magneto to the spark plugs of the cylinders.

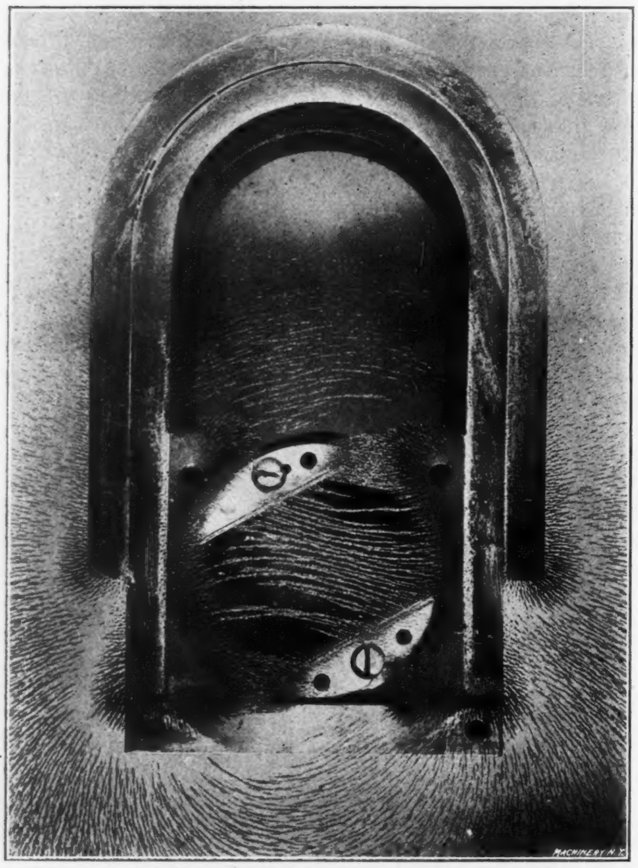


Fig. 5. Showing Lines of Force with Armature in Position Midway between those of Figs. 3. and 4

Various Systems of Ignition in Gas Engines

There are two systems of gas engine ignition, for either of which a magneto may be used advantageously. These are known as the make-and-break and the jump-spark systems. The spark, or flash, rather, in the former is obtained by sending a comparatively low-voltage current through a mechanism passing through the cylinder walls. At the proper time, two portions of this mechanism break or snap off, and the result of this break in the circuit is a hot flash, which serves to ignite the charge in the cylinder. The same result will be obtained in the open air if the two terminals of a set of batteries are taken in the hand, connected, and then separated with a "wiping" motion. A bright flash will be seen, which corresponds to the igniting spark of the make-and-break system.

The Jump-spark System of Ignition

The jump-spark system is in more common use than the make-and-break, and is especially well-adapted for magneto service. This system is so well known that it is useless to describe it in detail, and suffice it to say that when the connection is made, the current jumps across a small gap between two points of the spark plug screwed into the cylinder, and in so jumping, a hot spark is formed. Although this space is scarcely ever more than 1/32 inch wide, it is well known that a high voltage is required to cause a current to jump even an infinitesimal gap, and as the hot gases and compression in the cylinder increase the resistance, it is necessary to furnish a sufficiently high electromotive force to the current to enable the spark to jump at least half an inch in the open air. This requires a pressure of from 10,000 to 20,000 volts, and because of the high voltage used, this is known as the "high-tension" system. The make-and-break type of ignition, by virtue of its lower voltage, is known as the "low-tension" system.

Principles of the High-tension Magneto

Batteries, of course, cannot furnish this tremendous voltage required for the jump spark, and it is the duty of the coils to "'step up" the current to the final fifteen or twenty thousand volts. A "step up" transformer consists of two coils, one within the other, known as the primary and secondary. The current from the source of supply is led through the coarser, or primary winding, and this "induces" a very high voltage current in the many turns of fine wire of the secondary winding. The amperage is reduced, however, in the proportion in which the voltage is raised. In order to induce this high voltage in the secondary winding, there must be an intermittent surging, or "piling up," of the original current. This is accomplished by means of a vibrator, or interrupter, through which the primary current passes, and by the alternate making and breaking of the contact through the medium of a magnet and spring the desired intermittent action is obtained.

A direct-current magneto can be introduced into the above-mentioned system of ignition, the vibrating coils being used in connection with this mechanical source of current in the same manner as with the batteries. In this case the magneto may be driven by either a belt or a friction pulley, and the necessity for any gears in this connection is eliminated.

The ordinary alternating-current magneto furnishing current for a high-tension ignition system, however, operates on a slightly different principle. In this case a non-vibrating coil is used, of the same general design as the step-up transformer previously described, but without the current-interrupting mechanism. Consequently the magneto itself is equipped with an interrupter in the form of a cam revolving in intermittent contact with one or more rocker arms, on the end of each of which is a platinum contact point through which the current passes when the cam forces that end of the rocker arm against another platinum point, and thus completes the circuit. This cam is generally attached to the end of the armature shaft, and is so timed that the circuit is closed whenever the armature is in such a position that it will deliver a maximum amount of current. This interrupter, or circuit-breaker, is used as the timer, the spark being advanced or retarded in the cylinders as the case containing the contact points is revolved forward or backward on the armature shaft. Because the current from the magneto is not absolutely constant, it is necessary that the machine be geared positively to the crankshaft of the motor in the proper relation so that connection will be made with the spark plugs through the timer only when the armature is receiving its maximum amount of current. In the ordinary four-cylinder motor magneto there are generally two high-voltage impulses, or contacts of the cam, for each revolution of the armature.

Some magnetos are made which will furnish a high-tension current without the necessity of a step-up coil, or transformer. Such a machine has two windings on the armature, the primary and secondary, so that in reality the transformer is combined with the armature, instead of being located in a separate box on the dash. A machine of this type is a *bona-fide* high-tension magneto, because the current is generated at the same high voltage as that at which it will be used in the plugs. The other type of magnetos, however, is sometimes erroneously called "high-tension" when used for jump-spark work, even though the current is actually generated at a low voltage in the machine, but it will be seen that these are actually of the low-tension type with a separate step-up coil to obtain the desired electromotive force. There should be some method of distinguishing between the two types, but because both systems are used for jump-spark service, the majority of persons seem to think that the same name will serve for each of these two entirely different forms of ignition supply.

TEMPORARY FORMS AND THE USE OF THE TYPEWRITER IN THE DRAWING-ROOM

By DESIGNER

In the May number of MACHINERY there is an article describing a method of making up temporary forms at small expense. Now this method, while producing the desired results, strikes me as being in the final analysis more expensive than the well-known and approved method of making positive blue-line prints; *i. e.*, the use of a Van Dyke or brown process negative, made from the original tracing.

In our shop we have often been obliged to produce a small

INVENTORY SHEET NO.21.

LOCATION	NAME OF ARTICLE	NUMBER ON HAND.

Fig. 1. Heading of Stock Sheet Blank

number of temporary forms at a time for special statements, inventory sheets, etc., when it would not pay to have forms printed. Our method is to make a tracing, properly ruled and headed, from which we make a Van Dyke negative, and from the latter, as many blue-line prints as desired, or if desirable, positive brown-line prints. The brown-line prints are by far more attractive and permanent, the lines showing a great deal more strongly than the blue lines.

The paper used as a base for sensitized brown print paper is a thin and very tough parchment, admits of much handling without damage, and is so transparent that after having made skeleton prints of the forms desired, properly headed and

INVENTORY SHEET NO.21.

LOCATION	NAME OF ARTICLE	NUMBER ON HAND
B-7-3-	MACHINE BOLTS 1 BY 7-1/2	26
B-7-3	MACHINE BOLTS 1 BY 8	22
B-7-3	MACHINE BOLTS 1 BY 8 WITH 2 HEX.NUTS	14
C-1-5	MACHINE BOLTS 1-1/2 BY 3	76
C-1-5	MACHINE BOLTS 1-1/2 BY 3-1/2	27

Fig. 2. Reproduction of Part of Stock Sheet made by filling in Positive Print on Typewriter

ruled, if it is desired to reproduce the information after the form has been filled out, blue prints can be made directly from it.

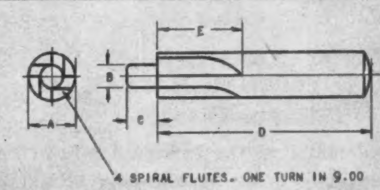
Considering the fact that the extra cost of the small amount of brown print paper required for such work is so trifling, I think it will be agreed that this method is superior to the one described in the May number, as an ordinary tracing and a negative for reproduction can surely be made in much less time than it takes to scratch out the lines and letters on the shellaced tracing cloth. Besides, it is possible to do much neater work directly on the cloth with ruling and lettering pen than by scratching with a sharp wire.

We have occasion once every year at inventory time to use about twenty-five stock sheets like the one the heading of which is shown in Fig. 1. The heading and ruling of this form are laid out on tracing cloth, from which a Van Dyke negative is made, as described above. From the latter, twenty-five or thirty positive prints are made, which are filled out on the typewriter with the names of the articles in the stock department, of which it is desired to obtain an inventory, and are used by the stock keeper as tally sheets. The quantities on hand of the different items are filled in the proper columns in India ink by hand. After the inventory is completed, a complete set of blueprints of the inventory sheets is made and a copy sent to the foreman of each department of the works. A reproduction of one of the finished sheets is shown in Fig. 2.

Previous to the adoption of this method the inventory sheets were manifolded on the typewriter, using as many carbon sheets as necessary to produce the requisite number of copies, and the work produced was not, by far, so neat as now, as the bottom carbon copy sheets were more or less blurred.

Having mentioned the use of the typewriter, I think some points regarding the use of this machine in the drawing-room will prove of interest to many readers, as I do not think that most engineers appreciate fully the utility and economy of this adjunct of the drawing-room. The following illustrations show some of its economical applications.

Fig. 3 shows a sheet of standard counterbores. These counterbores are alike in general plan, but being used for different pieces, the dimensions vary to suit requirements. The counterbore itself and the ruled columns headed with letters denoting the different dimensions, are drawn and inked in on white bond paper, and from time to time the columns are filled in on the typewriter with the dimensions of the counterbores required. As these counterbores are so nearly alike, it is not necessary to make separate drawings for each



A	B	C	D	E	NO. REQ.	PART NO.	ENTERED	DATE
.150	.093	.10	2.00	.50	6	X-9175	M.M.B.	4-12-06
.187	.125	.15	2.00	.60	12	X-7132	H.K.D.	4-21-06
.157	.125	.12	2.00	.50	12	A-6576	R.B.H.	4-30-06
.159	.093	.10	2.50	.60	6	R-7265	M.M.B.	5-11-06

Fig. 3. Sheet containing Dimensions of Standard Counterbores which are filled in on the Typewriter

one, and this scheme saves time and keeps the dimensions together on one sheet for quick reference. Of course the columns could be filled in by hand, but, as many different draftsmen have occasion to make additions to this list, they are filled in on the typewriter in order to keep the figures uniform, and this feature aids in making a neat and attractive drawing.

Fig. 4 is a reproduction of a bill of material sheet. Blue-

SEMET SOLVAY COMPANY
SYRACUSE N Y

BILL OF MATERIAL SHEET NO.21.

DEL. M.M.B. MAY 4-1910.

FOR 36" GAS PIPE LINE AT BALTIMORE PLANT

QUAN	DESIG.	DESCRIPTION	MATERIAL	LENGTH	DWG. NO.
28	PCS	36" FLANGED & RIVETED PIPE	STEEL	12'6"	1093
32	PCS.	36" FLANGED & RIVETED PIPE	STEEL	8'8"	1093
48	PCS.	2" CLEANING HOLE COVERS	C.I.		1093
3	PCS.	36" GATE VALVES	"		1093
24	FT.	3/4" COMMON BLACK PIPE	W.I.		
6	PCS.	3/4" GLOBE VALVES	BRASS		S-24

Fig. 4. Illustration showing Use of Typewriter for filling in Bill of Material Sheet

prints of this form usually accompany the drawings for a machine or building or whatever the case may be, on which a firm wishes to get bids from outside firms for furnishing or building same. It is a summary of certain parts shown on a drawing, on which estimates are desired. Some firms, as for instance, the Semet Solvay Co., Syracuse, N. Y., issue several hundred of these bills of material a month, and the cost of preparing these tracings reaches a large amount in a few weeks' time.

The blank forms were formerly furnished printed with the heading and ruling, and the lettering was done by hand. The

blanks furnished now are of thin tough parchment paper, printed and ruled as formerly, but the items are filled in on the typewriter, with greater neatness and general satisfaction, and an enormous saving in time and money. In fact, it is thought that the lettering can be done with the typewriter in one-sixth of the time formerly required by hand.

The machine for work of this kind should be equipped with what is known as the Pica Gothic style of type, all capitals. This is the style illustrated on the different forms reproduced herewith. These letters are square and vertical, and give a sharper outline than the style with which a typewriter is usually equipped.

Some firms who make blueprints from typewritten originals, use a piece of carbon paper, laid face up on the back of the sheet, to aid in making a heavy impression of the type, but I do not think that this is necessary, as ribbons with special inking which print very dense and black can be procured for this purpose. The carbon paper on the back is undesirable also, because it smears all over the back of the drawing.

In conclusion, I would like to state that many economies might result if different shop managers would give this subject their attention, and that new and economical uses for the typewriter may be found in almost every drawing-room and shop.

* * *

EMERGENCY BRAKE MOUNTINGS FOR AUTOMOBILE TRUCKS

By HERMANN HILL*

The subject of resisting the torsional strains caused by applying the emergency brake is one that seems to have been overlooked by the majority of designers of automobile trucks. The writer had occasion to design several trucks and found that this particular point received very little original thought by the truck builder, and that the majority of them were simply following the ideas of some one who was guilty of designing a faulty construction, such as is shown in Fig. 1. Let us

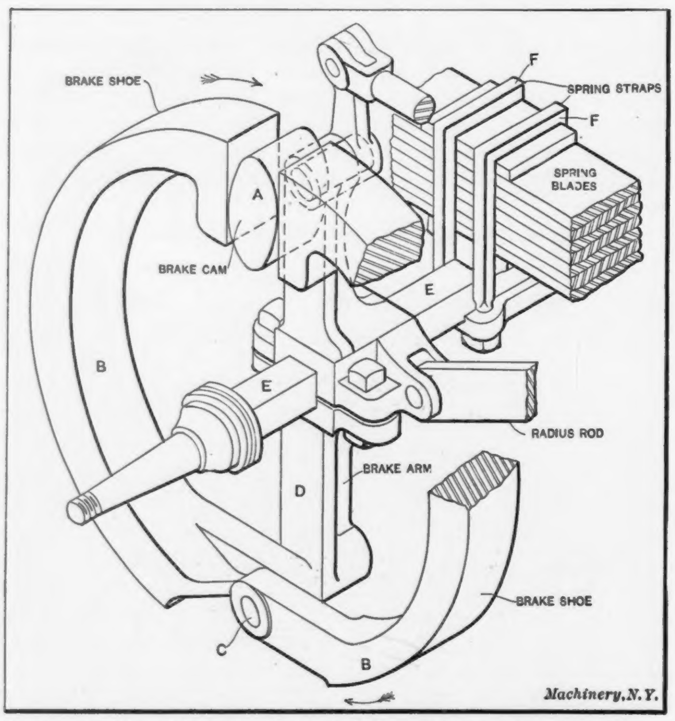


Fig. 1. A Weak and Inefficient Method of Mounting Expanding Band Brakes

for an instant imagine a heavy motor truck loaded with a weight of 7 or 8 tons, traveling at 15 miles per hour. When it is necessary to stop suddenly, the emergency brakes are applied. This, as can be seen, would act through the small brake cam *A*, expanding the shoes *B*. The friction between the brake drum and the brake shoes sets up a torsional strain, tending to turn the axle and the mounting on it. This torque has to be resisted first by the arm carrying the cam *A*, and the stud *C*, then through the brake-arm *D*, which is connected, as shown, to the axle *E*, and finally to the ¾-inch square straps *F*, which clamp the springs to the axle. It is, therefore, evident that the latter fastening is the last and weakest part to resist the enormous torque and it is also plain that this fastening was never intended to do such heavy duty. This axle and spring fastening is a remnant of the wheelwright's art, and as nothing better was suggested it was universally adopted by the makers of modern trucks. As it was originally applied to a wagon or carriage, it served this purpose admirably, but it certainly is not fitted to do the additional duty which would be necessary to stop a 50-horsepower motor truck.

* Address: 7?9 Cherokee St., Pittsburg, Pa.

What the writer considers to be a far better method of

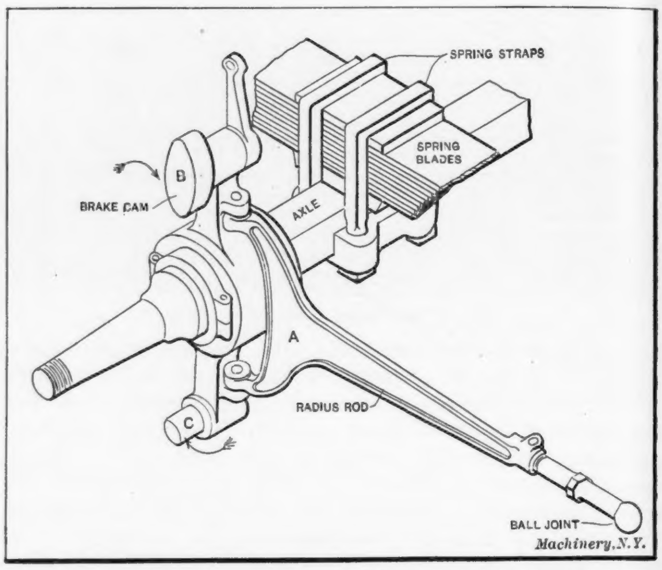


Fig. 2. Improved Method of Mounting Expanding Band Brakes

mounting an expanding brake is shown in Fig. 2. This mounting, as shown, is more rigidly constructed than that shown in Fig. 1, and has the additional advantage of the long radius rod, which is secured to the frame or chassis with its ball joint. This connection resists the torsional strain set up by the application of the brake and relieves the strain on the spring straps. The radius rod *A*, which is connected to the brake arm carrying the points *B* and *C* is, of course, mounted so that the brake arm can rotate upon the axle to permit a vertical movement of the latter, the other end of the radius rod being ball-socketed in some part of the frame or jack-shaft bearing. It is, therefore, evident from a study of this construction, that it relieves the axle and spring fastening entirely of any twisting action, leaving them as they were intended to be since their conception. To fasten the radius rod in this manner serves another purpose; namely, it gives the axle perfect freedom and will not strain the rod or its fastenings in going over rough roads where the axle is continually thrown out of alignment with the frame. It is, therefore, obvious that the ordinary radius rod shown in Fig. 1, which is simply strapped to the axle or fastened with clevices on either end and movable only in a vertical plane, does not permit any disalignment of the axle, but as this will always happen, the rod and its fastenings will have to suffer. The purpose of the radius rod is, as its name implies, to maintain the center distance between the axle and the jack-shaft, by permitting vertical motion of the axle in a fixed radius, and in doing this the rod is only under tensile or compressive strain. If not directly connected, it would in addition be subject to bending and twisting strains which would ultimately cause breaking of the rod or its fastenings.

* * *

Is it good practice to mount the motor and speed boxes on the housings of planers? It is a very convenient location; the motor and speed box are in view and accessible in case anything goes wrong. It is claimed, however, that the vibration and jar due to lack of balance of armature and poorly fitted gears will show on finished work. The inaccuracy resulting is negligible, but the appearance cannot be tolerated on work which is finished when it leaves the planer.

AUTOMOBILE FACTORY PRACTICE*

HABERER & CO.'S WORKS, CINCINNATI, O.

By ETHAN VIALL†

The jigs and fixtures used in the shops of Haberer & Co., Cincinnati, Ohio, makers of the Cino motor cars, are unusually complete, well designed and well made, owing principally to the liberal, up-to-date policy of the management, and the practical experience and mechanical knowledge of the designer and shop foreman, O. L. Snyder. Specially designed machinery is not used, as the term is generally understood, but American radial drills, Fosdick horizontal boring mills, Beaman & Smith cylinder boring machines, Brown & Sharpe cylinder grinders and other on-the-market machines make up the excellent shop equipment.

Cylinder Jigs

The shop operations on the double cylinders used do not differ materially from those in other shops doing a similar class of work. The ends and side bosses are first surfaced off on a milling machine, then the cylinders are placed in the jig, Fig. 1, and the six end holes drilled. These holes are used as locating holes for the subsequent operations as well

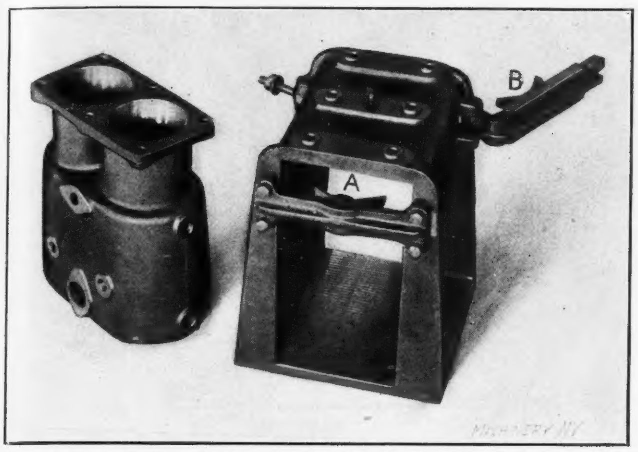


Fig. 1. Jig for Drilling the Six Holes in the Flanges of the Cylinders which are used as Locating Holes in the Subsequent Operations

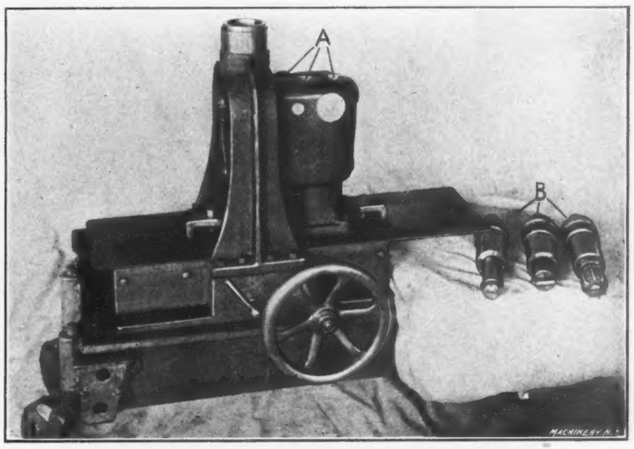


Fig. 2. Indexing Jig for Boring and Reaming the Four Valve Cage Holes

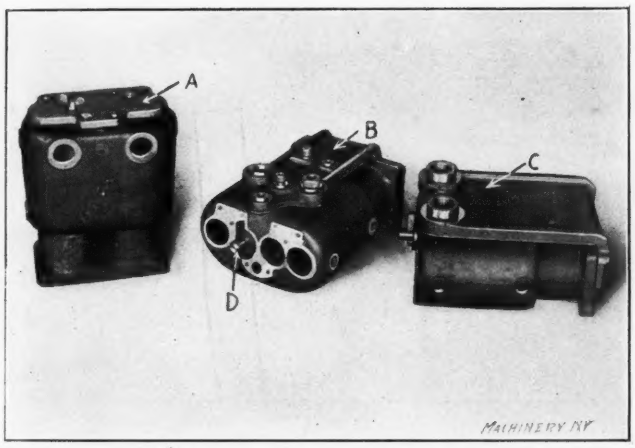


Fig. 3. Jigs for Drilling the Various Small Holes in the Cylinder Castings

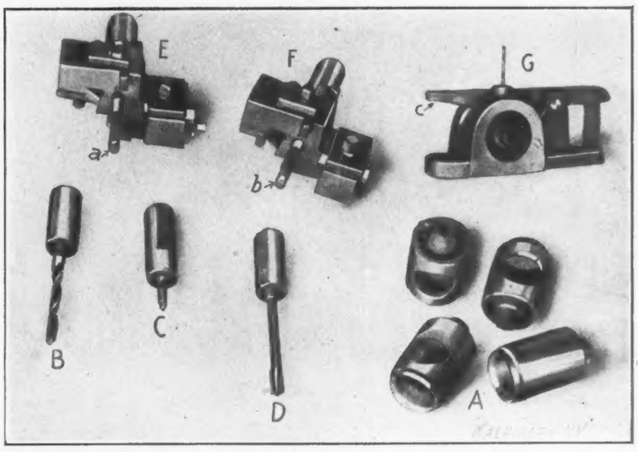


Fig. 4. Tools used in Making the Valve Cages

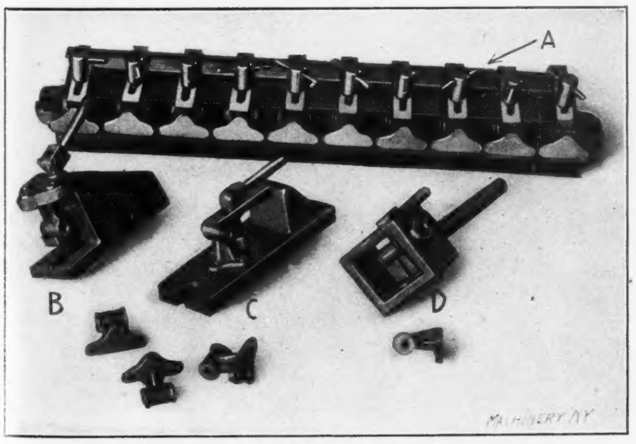


Fig. 5. Tools used in making the Rocker Arm Brackets

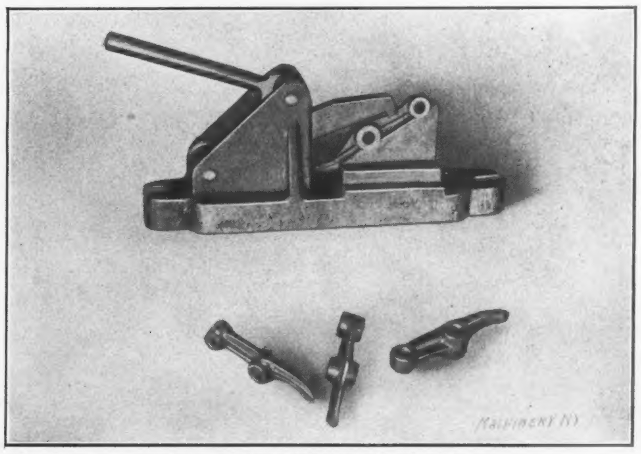


Fig. 6. Jig for Milling the Rocker Arm

* For additional information on automobile factory practice and kindred subjects, see: "Automobile Factory Practice in the Olds Motor Works, Lansing, Mich.," July, 1910; "Making an Automobile Steering Wheel," July, 1910; "Laying Out Steering Gears for Automobiles," May, 1910, engineering edition; "Milling Fixtures for Automobile Parts," March, 1910; "Automobile Factory Practice in the Nordyke & Marmon Co.'s Shops," January, 1910, engineering edition; "Design of Automobile Springs," January, 1909, engineering edition; "Machining Cylinders and Pistons for Automobile Engines," January, 1909, engineering edition; "Tools for Drawing Seamless Automobile Lamp Hoods," February, 1909; "Organization and Equipment of an Automobile Factory," March, 1909, engineering edition; "Special Tools and Devices for Automobile Factories," April, 1909, engineering edition; "Broaching Automobile Parts," April, 1909; "Special Automobile Factory Tools and Devices," May, 1909; "Machines and Tools for Automobile Manufacturing," June, 1909; "Treatment of Gears for Automobile Transmissions," October, 1909, engineering edition; "Automobile Factory Practice in the Dayton Motor Car Co.'s Shops," October, 1909; "The Design and Manufacture of a High-Grade Motor Car," October, 1909, engineering edition; "Manufacturing Methods in the Stevens-Duryea Co.'s Works," October, 1909, engineering edition; "Efficient System for the Rapid Assembly of Motor Cars," October, 1909, engineering edition; "Manufacturing Automobile Equalizing Gears," December, 1909; "Drop Forge Work in an Automobile Shop," September, 1908; "Automobile Engine Building in a Steam Engine Plant," April, 1907. See also MACHINERY'S Reference Series pamphlet No. 59, "Machines, Tools and Methods of Automobile Manufacture," and No. 60, "Construction and Manufacture of Automobiles."

† Associate Editor of MACHINERY.

as for bolting the cylinders to the crank case. It will be noted that the cylinders are located in this jig by being held between the swiveled V's *A* and *B*, which grip the cylinder castings between the waterjackets and the flanges, the milled bosses and lower end of the casting locating the cylinder in the desired relation to the finished sides of the jig box. After leaving this jig the cylinders are bored on a Beaman & Smith upright boring mill and then placed in the indexing jig Fig. 2, where the valve cage holes *A* are bored and reamed with the tools shown at *B*. The moving table of this jig is operated by the hand wheel, which turns a pinion meshing in a rack. The table is located for the four holes by the latch lever shown to the left of the hand wheel. The various side and end holes not already finished are drilled by means of the jigs shown in Fig. 3. *A* is the jig for drilling the small top holes, and is located by plugs which fit the valve cage holes. *B* is the jig for drilling the holes for the spark plug and water-pipe; and *C* is the jig for drilling the holes for the exhaust pipe and bracket. The jigs *B* and *C* are both located properly by dowel pins which enter the holes in the cylinder flanges, and are clamped by a rod which passes through one of the cylinders and out through a valve cage hole, where the rod is locked by a washer and tapered wedge as shown at *D*.

Machining the Valve Cages

The valve cages, *A* Fig. 4, which fit the holes that are bored in the jig shown in Fig. 2, are first caught in a three-jawed universal chuck on the open end, and are roughed out to within 1/32 inch of size of the other end; then they are placed in the universal chuck of a turret lathe, where the center hole is drilled with the drill *B*, and the drilled hole is then bored for about 1/4 inch deep with the boring tool *C*, for the purpose of facilitating the starting of the reamer *D*, which is next run through. This reamed hole is used as a guide for the pilots *a* and *b* of the roughing and finishing box tools *E* and *F*, and finally the cages are placed on a mandrel and ground. The jig *G* is used to hold the valve cages while drilling the small holes, into which the locating pins are driven. The spring lever *c* is worth noting, as it serves to both clamp and locate the cage.

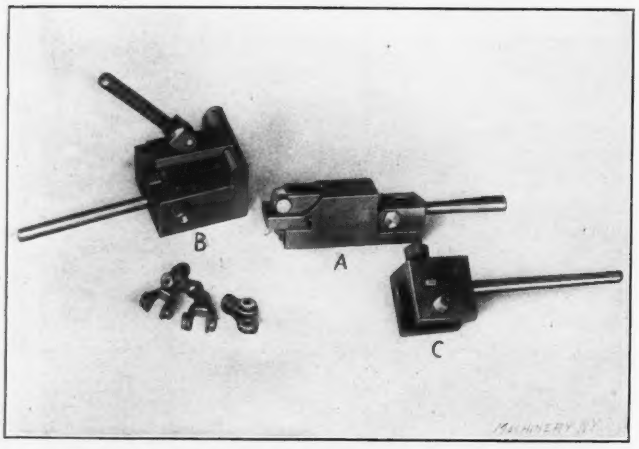


Fig. 7. Jigs for Drilling and Milling the Rocker Arm Clevis

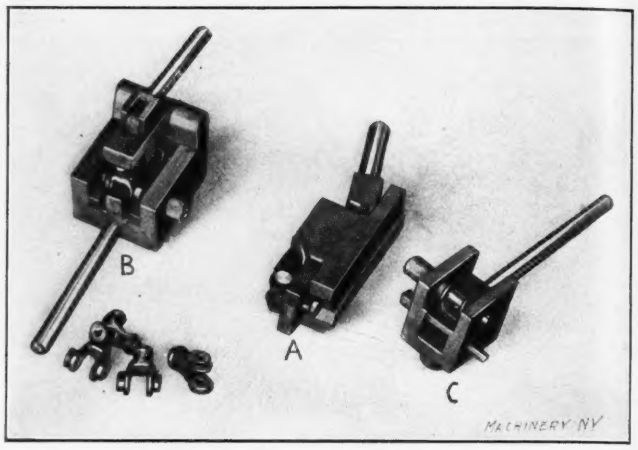


Fig. 8. Use of the Rocker Arm Clevis Milling and Drilling Jigs

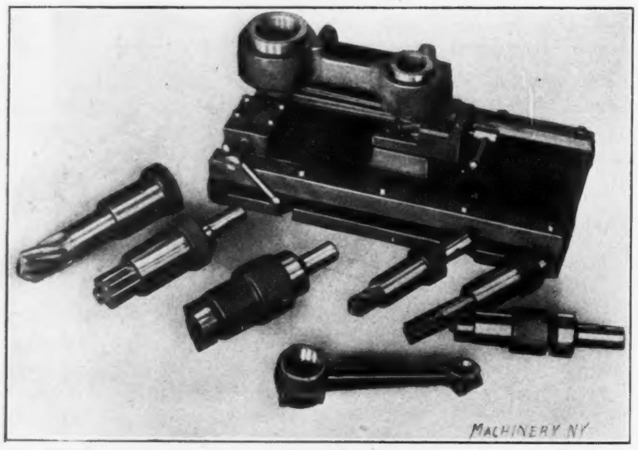


Fig. 9. Drilling, Reaming and Facing Jig and the Tools used for Machining the Connecting-rods

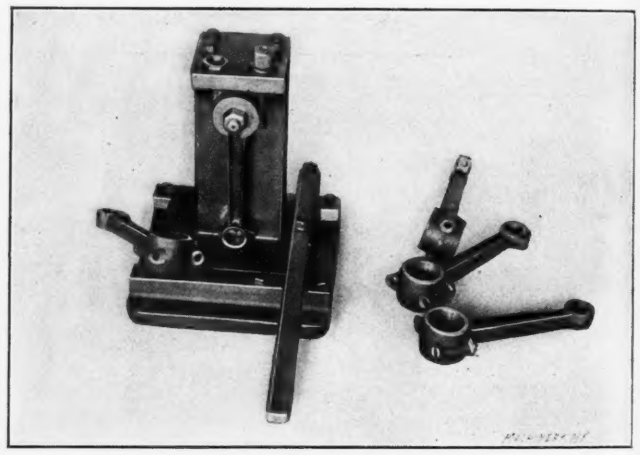


Fig. 10. Jig for Drilling the Holes in the Connecting-rod Caps

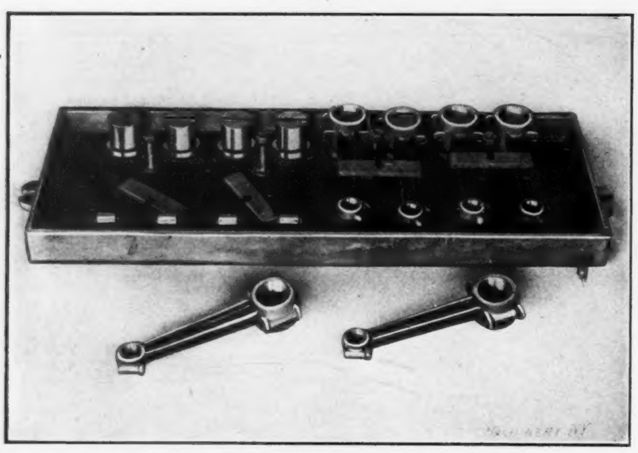


Fig. 11. Milling Jig used in Splitting the Connecting-rod Case into Two Pieces

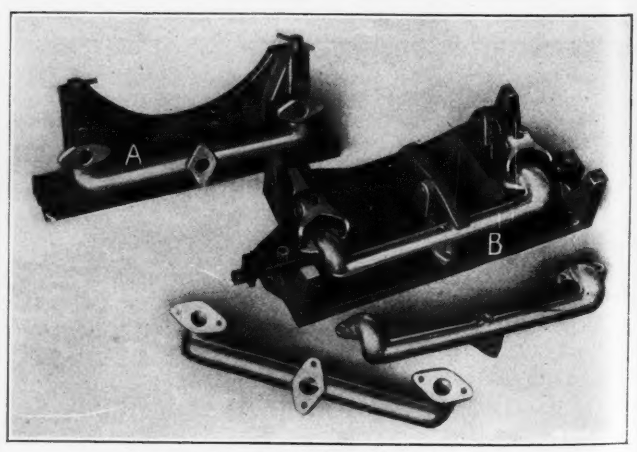


Fig. 12. Milling and Drilling Jigs for the Inlet Water Pipes

Rocker Arm Brackets

The rocker arm bracket bottoms are milled off in the jig *A* shown in Fig. 5. This operation is practically continuous, as the pieces are replaced at one end, when the milling cutter is working at the other. For milling operations, where a quick-acting clamp may be necessary, those shown on the jig *A* are commendable, as the jar of the cutters has a tendency to loosen almost anything but a screw clamping device. For ordinary drilling the eccentric clamps shown on the jigs *B*, *C* and *D* are both quick and effective. Taking these jigs up in the order in which they are shown, *B* is used to drill the three holes in the base of the bracket, the piece being pressed up against the bottom of the member in which the drill bushings are set, by a clamp operated by the eccentric lever on top. The jig *C* holds the bracket while the ends of the bearings are surfaced off with a straddle mill, the piece being located by dowel pins over which the base holes fit, and is clamped as shown. The jig *D* holds the bracket while drilling out the bearing hole, the piece being located by dowel pins in the same manner as in the jig *C*. The rocker arms are straddle milled in the jig shown in Fig. 6, which is a model of simplicity, and easy to operate, an eccentric locking lever being used, as was the case in those just described. The holes in these levers are punch marked and then drilled, as the distance between the holes may vary somewhat.

The rocker arm clevises are centered and straddle milled in jig *A*, Fig. 7. The fork holes are drilled in the jig *B*, and the end hole drilled in the jig *C*. The construction of these jigs is more fully shown in Fig. 8.

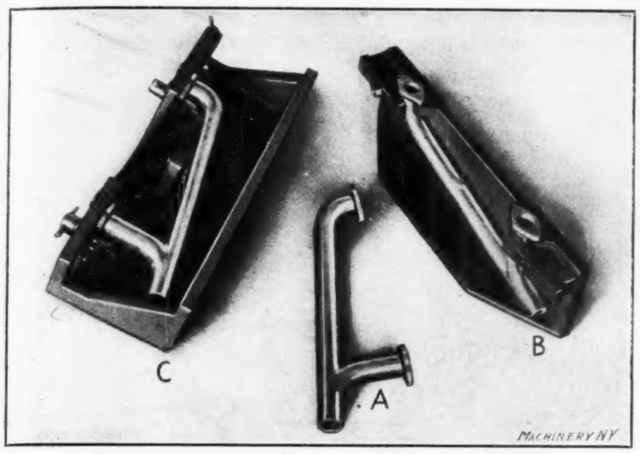


Fig. 13. Milling and Drilling Jigs for the Outlet Water Pipes

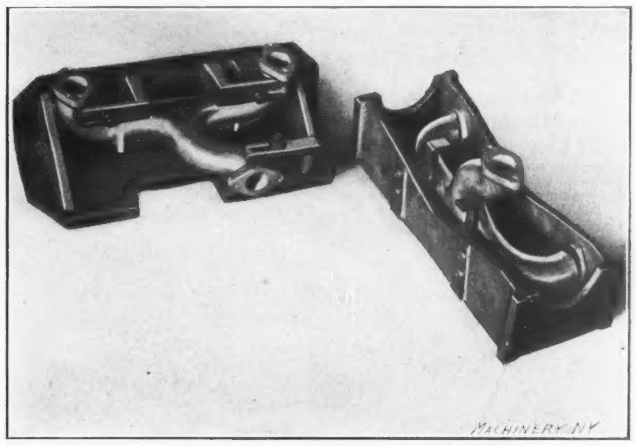


Fig. 14. Milling and Drilling Jigs for the Intake Pipes

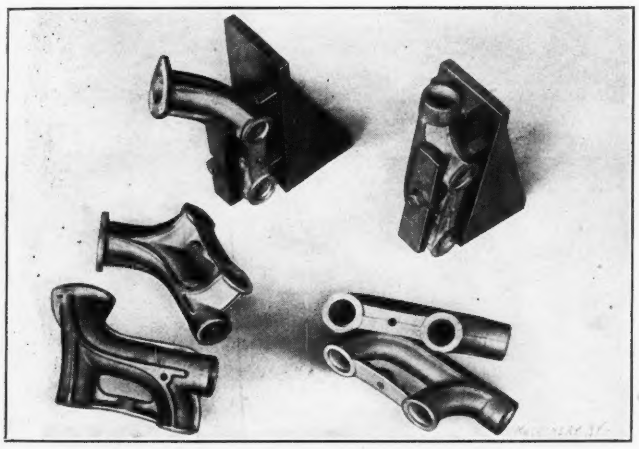


Fig. 15. Milling Jigs for Two Different Shapes of Exhaust Manifolds

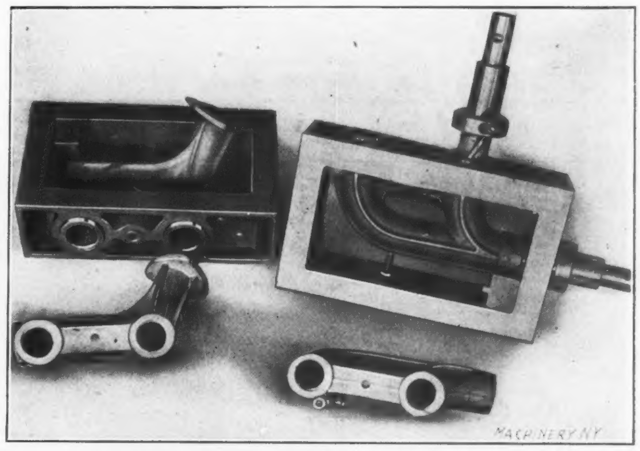


Fig. 16. Drilling Jigs for Two Different Shapes of Exhaust Manifolds

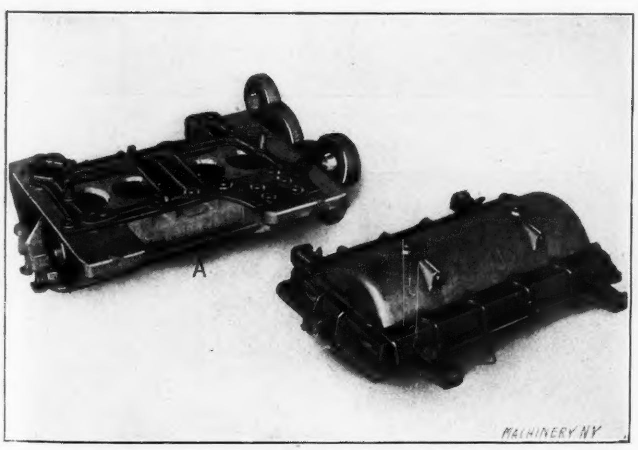


Fig. 17. Drilling Jigs for Upper and Lower Crank Case

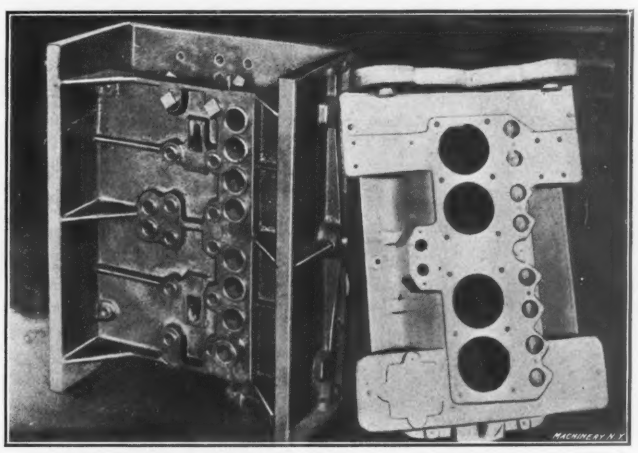


Fig. 18. Drilling and Reaming Jig for Upper Crank Case, also showing Model Drilling and Reamer Rack in the Background

Connecting-rod Jigs

The first operation on connecting-rods is to drill, ream and face the end holes in the jig shown in Fig. 9, which is made to be used on a single spindle drill press, the upper part of the jig being made to slide in the bed. The connecting-rods are locked by two screws, operating V-clamps, and the various tools used have guide bushings fastened on the shanks, which have been ground and lapped to fit the bushings of the jig.

The cap-screw holes of the connecting-rods are drilled in the jig shown in Fig. 10, which is made to slide on the same

principle as the one just described, though a small hand lever is used to operate it in this case. A point to note in all of these jigs is that where more than one operation is necessary for any particular hole, the jig bushing is made extra large, and then bushings for the different tools are carefully fitted into it, and where possible these bushings are fastened to the shank of the tool used, avoiding the annoyance of misplaced bushings. After being drilled, as shown, the caps are split in two pieces in the milling jig shown in Fig. 11.

Pipe Milling and Drilling Jigs

The various pipe connections used on a gas engine for an automobile are generally awkward things to handle, so the set of jigs used for the pipes on the Cino engine are here shown, though little explanation is needed. *A*, Fig. 12, is the flange milling, and *B* the flange drilling jig for the inlet water pipes, the latter jig being shown upside down. *A* in Fig. 13 is the outlet water pipe, and jig *B* is the milling, and *C* the drilling jig. Fig. 14 shows jigs for drilling and milling the intake pipes, and Figs. 15 and 16 show respectively the jigs for milling and drilling the exhaust pipes. *A* and *B*, Fig. 17, are the jigs used for drilling the top and bottom crank cases, while another top crank case jig is shown in Fig. 18. The jig shown in Fig. 19 is used for holding the gear-case covers while surface milling the contact edges.

Gear Marking and Keyseater Jigs

The crank, cam shaft and magneto gears all bear certain definite relations to the gear with which they mesh, so in order to avoid the usual "cut-and-try" method these gears are marked before being taken from the keyseater. This is accomplished by using the keyseating and marking jigs shown in Fig. 20, *A* being a magneto gear jig; *B* a jig for the cam shaft gear, and *C* a jig for the crank gear. As can be easily seen, the swinging punches when tapped with a hammer, will mark the gear in relation to the position of the keyway. These jigs are used on a Baker keyseater as is shown in Fig. 21. Fig. 22 shows a Fosdick horizontal mill at work, boring out the crank bearing cam shaft and other holes in the crank case, an enlarged view being shown in Fig. 23.

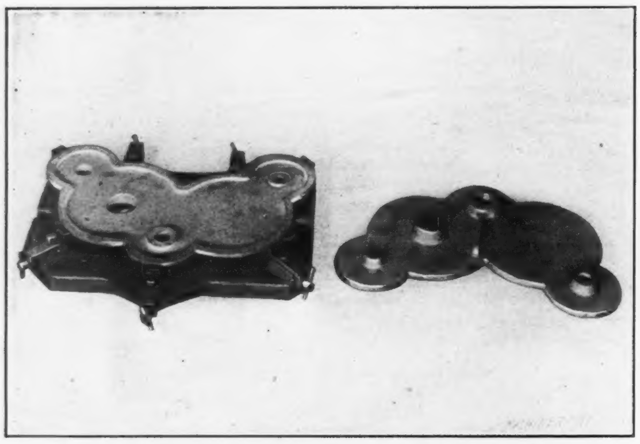


Fig. 19. Milling Fixture for the Gear Case Covering

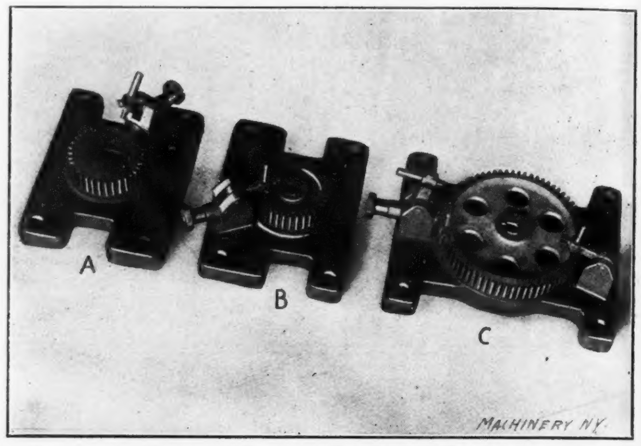


Fig. 20. Keyseating Fixture used for Holding and Marking the Gears

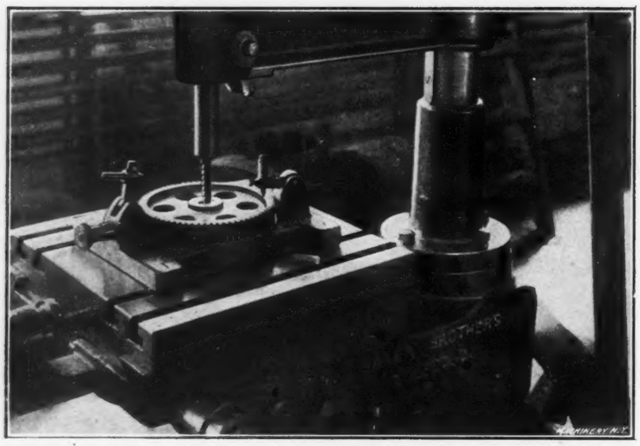


Fig. 21. Showing Method in which Jig is used on the Keyseater for Marking the Gears

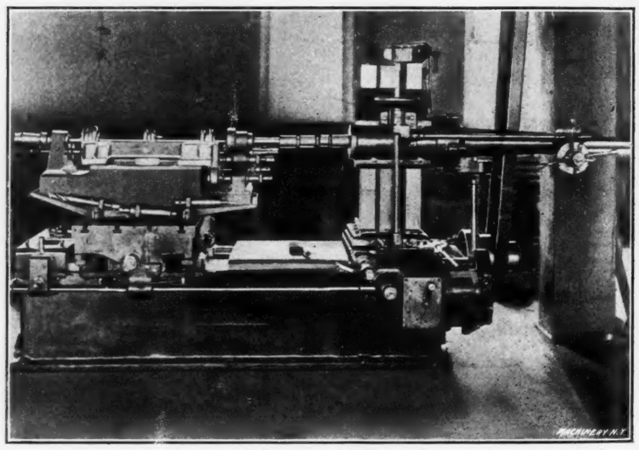


Fig. 22. Fosdick Boring Mill at work on a Crank Case

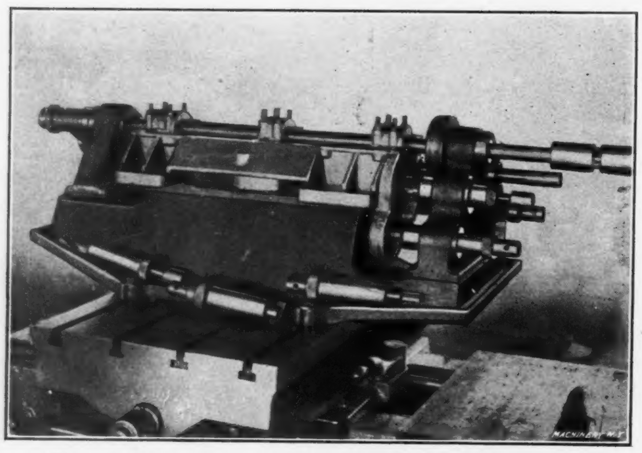


Fig. 23. Fixture and Tools used for Machining the Crank Case

Fig. 24. View of the Hardening Furnace

A model hardening room is shown in Fig. 24, *A* and *B* being the hardening furnaces and *C* a cyanide bath. On top of the cyanide heating crucible is a shovel-like holder for hardening valve stems, which consists simply of a piece of flat iron with a handle on it, the flat part having twelve holes in it through which are put the valve stems. The shovel is placed over the bath allowing the stems of the valves to hang in the cyanide, but protecting the heads.

Thanks are due to Mr. W. F. Meyer for courtesies extended to us while obtaining the material given.

* * *

AUTOMOBILE MOTOR-TESTING PLANT

By F. B. HAYS*

The accompanying illustrations show a universal motor-testing plant for testing automobile motors. This plant was designed to overcome the difficulties arising from the lack of facilities for giving motors of various sizes and construction a block test without building special blocks for each size of motor. At first sight this would be considered a very difficult matter, as every make and size of motor varies. However, after some consideration of the subject a general idea for making the plant was conceived and general details worked out accordingly. The chief difficulty lay in the necessity of holding four separate motors or a three-point suspension motor on the same block.

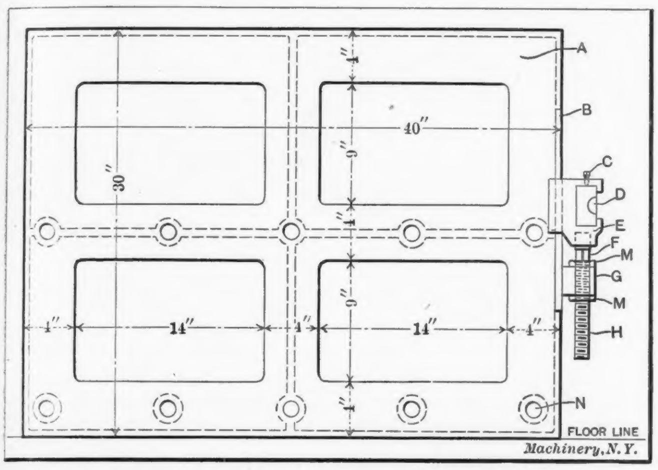


Fig. 1. Side Elevation of an Assembled Testing Block

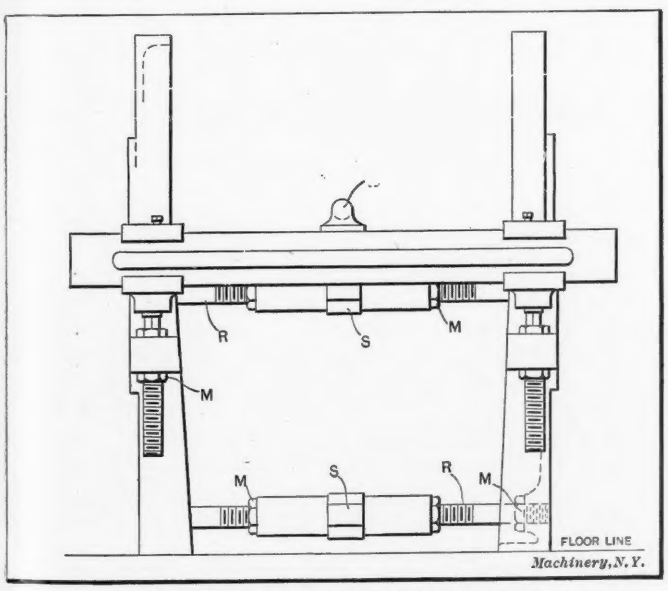


Fig. 2. End Elevation of Assembled Testing Block

Fig. 1 shows a side elevation of an assembled testing block which was devised and proved satisfactory. For a four-support motor the supporting plates *B* are bolted to the face or the top side of blocks *A*. For a three-point suspension motor, the side-supporting plates are bolted to the face and the bearing is fixed to the beam *D* by means of trunnions or by other means as required by the construction of the motor. The proper alignment of the motor is obtained by raising or lowering the beam *D* by means of adjusting screw *H* which is operated by the square portion *F*, beam *D* being supported by the yoke *E* which travels on the guide *B*. The width between the yokes *E* is maintained by set-screws *C*. The locking nuts *M* hold the adjusting screws *H* in the required position. Fig. 2 shows an end view of this assembled testing arrangement, the distance between the side blocks being maintained by turn-buckles *S*, this required distance being governed by the size of the motor to be tested. All the locking nuts should be held rigid by means of lock-washers so that once the testing arrangement is set it will not require further attention. The rods *R* are used for regulating the width between the sides of blocks *A*; W is the trunnion for operating the front bearing of the three-point suspension motor.

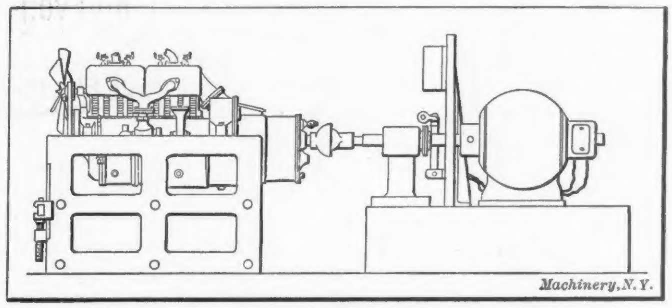


Fig. 3. Unit Power Plant for Testing Motors by means of an Electric Dynamometer

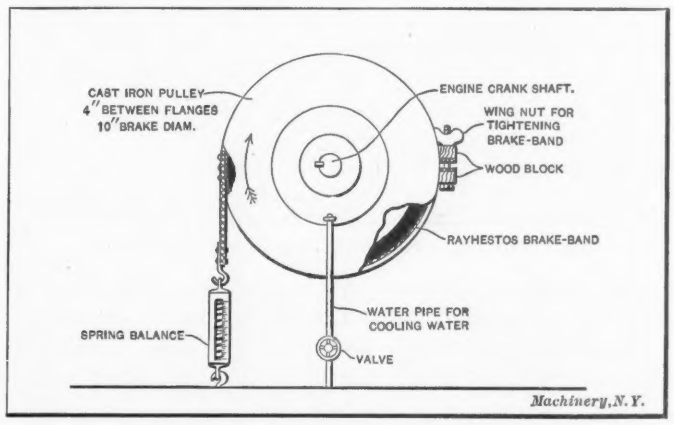


Fig. 4. Friction Brake for Testing Motors

Fig. 3 shows a unit power plant for testing motors which are connected to an electric dynamometer. The motor may be connected with a friction dynamometer type of prony brake with equal facility and the horsepower obtained with little difficulty. Where it is not desirable to maintain an expensive outfit, the friction brake of the type shown in Fig. 4 will be found very convenient for general work. This brake is clearly illustrated and it will not be necessary to describe it further. The accompanying table gives the various horsepowers for different speeds and brake loads as determined by the dynamometer tests.

DYNAMOMETER POWER CHART—DIAMETER OF PULLEY = 10".
Without Brake Arm 360° Contact
Formula: Brake Load × R. P. M. × 0.00008 = H. P.

Brake Load	Revolutions per Minute								
	500	800	1000	1200	1400	1500	1600	1700	1800
	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.
100	4.0	6.4	8.0	9.6	11.2	12.0	12.8	13.6	14.4
125	5.0	8.0	10.0	12.0	14.0	15.0	16.0	17.0	18.0
150	6.0	9.6	12.0	14.4	16.8	18.0	19.2	20.4	21.6
175	7.0	11.2	14.0	16.8	19.6	21.0	22.4	23.8	25.2
200	8.0	12.8	16.0	19.2	22.4	24.0	25.6	27.2	28.8
225	9.0	14.4	18.0	21.6	25.2	27.0	28.8	30.6	32.4
250	10.0	16.0	20.0	24.0	28.0	30.0	32.0	34.0	36.0
275	11.0	17.6	22.0	26.4	30.8	33.0	35.2	37.4	39.6
300	12.0	19.2	24.0	28.8	33.6	36.0	38.4	40.8	42.2
325	13.0	20.8	26.0	31.2	36.3	39.0	41.6	44.2	46.8

* Designer and Engineer, Cole Motor Car Co., Indianapolis, Ind.

BENDING DIES FOR THE RIBBON FORKS OF THE ELLIS ADDING TYPEWRITER*

By RALPH E. FLANDERS†

If the reader will cast his eye upon Fig. 1 and note the very complicated twists which have been given to the punchings there shown, he will doubtless be surprised when he is told that practically all of the bending in the first sample, and absolutely all of it in the second sample, was done at one stroke of the press in a single die. If he is not surprised he ought to be. The operation of bending the blanks for these pieces comes pretty close to being the most complicated presswork job ever undertaken. The designer of the dies, however, Mr. Burchett, of the Ellis Adding Typewriter Co., Newark, N. J., modestly asserts that tools of this kind are not uncommon. But they certainly are not so common as to be well-known, so it is fitting that an achievement of this kind should be signalized by detailed illustration and description.

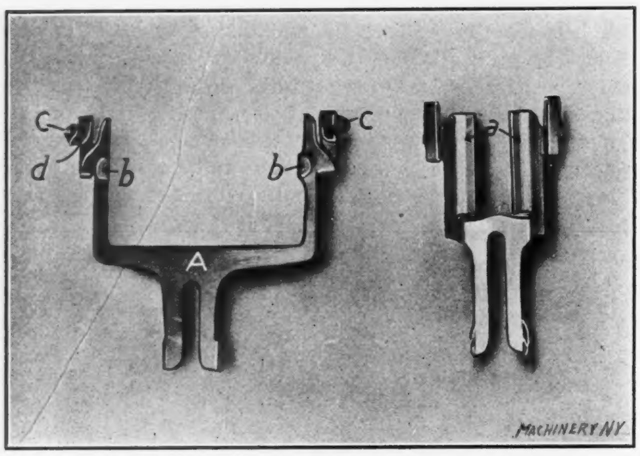


Fig. 1. The Ribbon Forks of the Ellis Adding Typewriter

The operation of making the large ribbon fork, *A*, consists simply in blanking in one die and bending in a second. The simpler of the pieces shown at the left of Fig. 1 has a third operation performed; this is merely the bending of the two inner blades as shown at *a*, and the only reason for making a separate and third operation of this is that, if performed in the main bending die, it would not permit the removal of the work.

The Blanking Dies

The blanking dies for these two parts are shown in Figs. 2 and 3. Their chief interest lies in the fact that two operations in a single die are required in one case, and three in the other, for cutting out the complex blank. These operations are so distributed that there is no danger of drawing or distorting the slender blank in the process; at the same time, no dangerously slender parts are required in the punch, this being, in fact, the main purpose of the sub-division of the blanking operations.

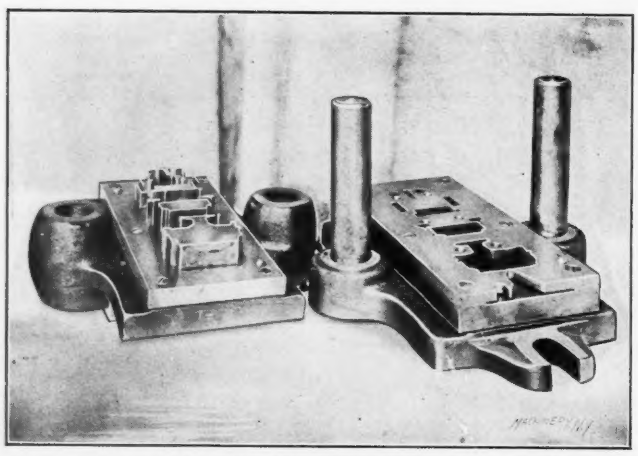


Fig. 3. Punch and Die for Blanking out the Adding Machine Ribbon Fork

The die for cutting out the narrow or typewriter-ribbon fork, is shown in Fig. 2. As may be seen, it is of the self-contained type, provided with two carefully fitted posts for guiding and aligning the punch. This construction gives all the advantages of the sub-press die so far as ease of changing and setting up in the punch-press is concerned. It has the merit, of course, of being much less expensive than the sub-press, and on all ordinary work the makers have found it to be eminently satisfactory.

The blanking dies for the large or adding-machine fork are shown in Fig. 3. The cutting out of this blank is a three-operation process, the arrangement of the punches of which is shown in Fig. 4. The first operation at *e* cuts out all the slots. The narrow blade-like punches work in the solid strip of metal, so there is no tendency for them to deflect one way or the other and be broken. In this operation, also, part of the stock is punched from the central blanked space. In the second step, shown at *f*, the corners of the arms are rounded and the blanking of the central space is completed. In the third step, *g*, the completed blank is outlined and punched out.

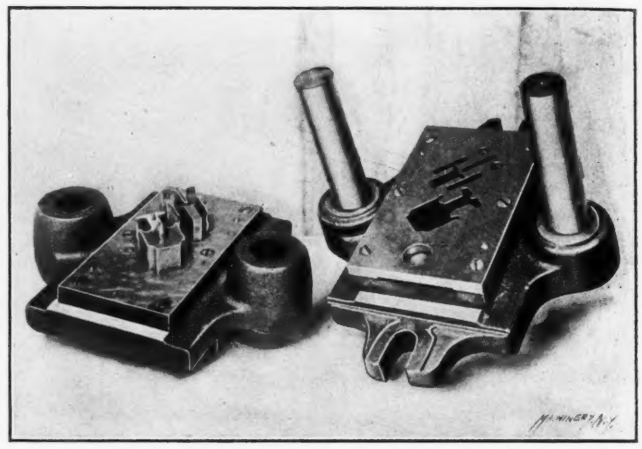


Fig. 2. Punch and Die for Blanking out the Typewriter Ribbon Fork

The condition of the strip of metal for each of the three steps of the blanking operation is shown in Fig. 5. It will be noted at *g* that the strip is entirely separated through the middle. To prevent the two sides of the strip from spreading or coming together, and thus giving a blank of incorrect shape, pilot holes h_1 h_1 are punched in the first step. In steps *f* and *g* pilots on the punch enter and fill these holes before the punching commences, as shown at h_2 h_2 and h_3 h_3, thus firmly and accurately locating the stock.

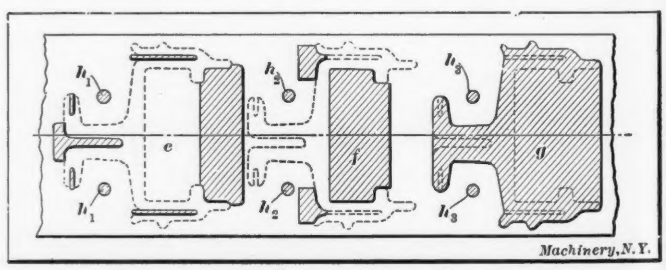


Fig. 4. Lay-out of Punches for the Die shown in Fig. 3

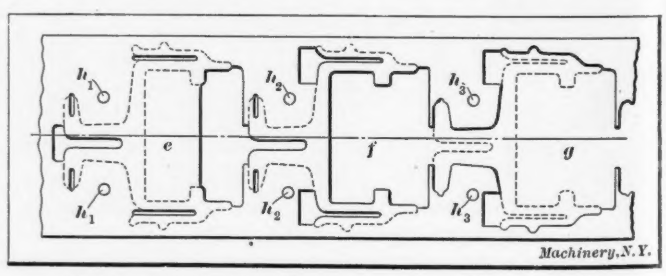


Fig. 5. Successive Operations on the Strip of Metal in the Die shown in Fig. 3

It is evident from a study of Figs. 4 and 5 that stock might have been economized by telescoping the head of one

* This is the third of a series of articles on the principles of action and tools used in the manufacture of a special typewriter. The practice, while typical of the class of manufacturing represented, is novel in many respects.—EDITOR.

† Address: Springfield, Vt.

blank in between the arms of the succeeding one. If the reader attempts to lay out a punch and die in this manner for this piece, however, he will find difficulty in getting proper support for the slender punch and die shapes required. The only practical alternative to the construction shown would be a costly sub-press die in which the blank is cut at one stroke, and the punch parts and the stock are supported by the strippers and shedders. But the success of such a scheme would be problematical.

Of the two bending dies, the construction of which is the main text of this sermon, that shown in Fig. 6 is for the narrow typewriter ribbon fork, while the one illustrated in Figs. 7 to 11 inclusive is for the wider fork shown at *A* in Fig. 1. The die shown in Fig. 6, while quite as complicated and ingenious

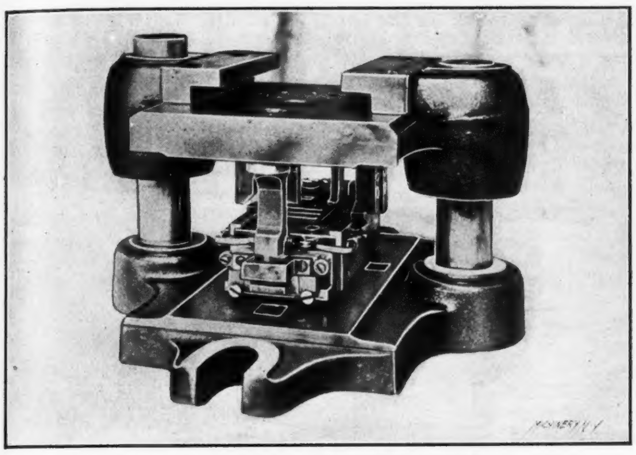


Fig. 6. Main Bending Die for the Typewriter Ribbon Fork

as the other, will not be described in detail. The die selected for description has one or two features of particular ingenuity, which should be capable of more extended application in bending operations in general.

Description of the Bending Die

Fig. 7 shows the bending die with the punch-plate removed, and the work *A*, in place as it appears at the conclusion of the operation, ready for removal. The same reference letters apply to all the engravings, Figs. 7 to 11. The punch holder shown in Fig. 8 is supplied with a number of projecting members, some of which operate directly on the work, but most of which act through their wedge-shaped faces to operate

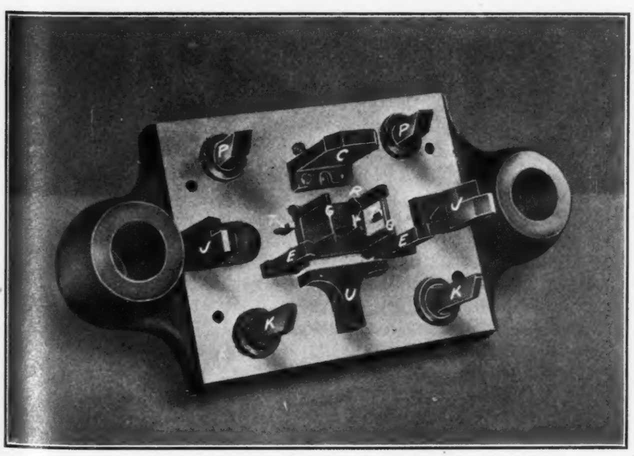


Fig. 8. Punch and Operating Parts for Die shown in Fig. 7

slides in the die, as shown more in detail in Figs. 9, 10 and 11.

The first thing that takes place (see Fig. 9 in particular) after the blank has been laid in position and the plunger starts to descend, is the throwing into place of matrix fingers *B* by the action of wedge *C* in the punch, which comes in between them and spreads them apart. These fingers, as shown by the dotted lines at B_1, are normally swung in together, permitting the placing or removal of the work, but when forced into the operating position they pass over the blank as shown, holding it down at the inner ends. The thin blade-like projections at the end of matrix levers *B* enter slots cut to receive them in the faces of blocks *D*. These blades are thus supported so as to prevent breakage under the pressure of subsequent bending operations.

As the ram of the press continues its downward movement, the next members on the punch holder to come into operation are the two wedges *E*, one of which is shown in detail in Fig. 10. These force together the inner ends of pivoted supporting levers *F*. One of these levers is shown in its outer or inactive position in the lower or sectional view Fig. 9, while the left-hand one is shown in its normal or working position in Fig. 10, where it has its working face flush with that of matrix lever *B*. Now as the plunger of the press continues its descent, the next member on the punch holder to be operated is the bending punch *G*, which, as shown in Fig. 10, bends downward the inner tab of the blank (see *b*,

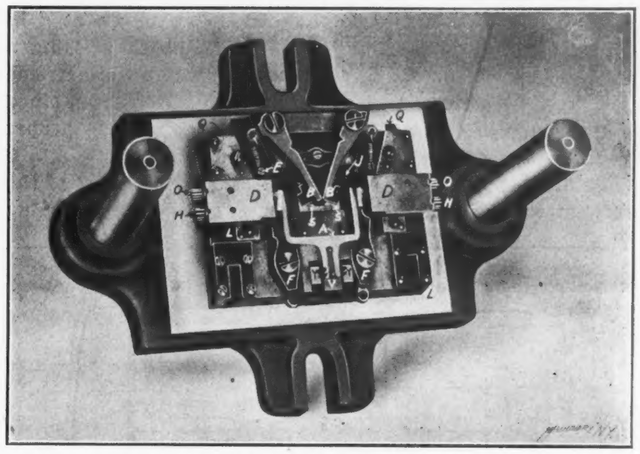


Fig. 7. The Die for the Complete Bending Operation on the Adding Machine Ribbon Fork

Fig. 1) over lever *F*, the blank meanwhile being supported between *B* and *F*.

The long tail of the blank has now to be wrapped clear around the blade of matrix lever *B*. The provision made for this wrapping operation is novel. As shown in Fig. 10, spring plungers *H* are provided which are capable of being moved

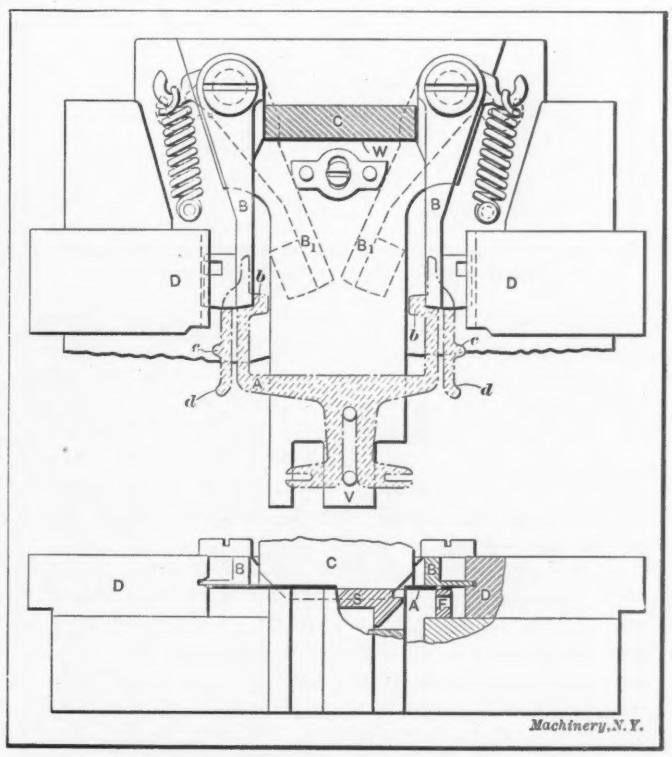


Fig. 9. Diagrammatic View of Die shown in Fig. 7, illustrating the Preliminary Movements

inward, and may also be rotated. In the first place, wedges *J* descend and force plungers *H* inward, against spring pressure as shown. The lip of plunger *H* supports the work up against the under side of the blade of *B*. After this has taken place wedges *K* descend, drawing slides *L* toward the front. These are slotted to engage pins *M* in rocking sectors *N*. The teeth in the periphery in these sectors engage gear

teeth cut in the shanks of plungers *H*. As *K* descends, therefore, plungers *H* are rocked in the direction shown by the arrow in the small detail at the lower right-hand corner of Fig. 10. By means of this rocking the tail of the blank is wrapped around blade *B* of the matrix lever. So much for the first bend.

As shown best in Fig. 7, there is also a second plunger, *O*, alongside of *H* in each of the two blocks *D*. As the ram continues to descend, a second inclined face on wedge *J* throws these plungers inward, over the tails of the blank. Then wedges *P* operate a second set of slides *Q*, through corresponding pins and rocking segments to rotate plungers *O*, wrapping the work a second and final one-half turn about blade *B*, as shown in the sketch at the lower right-hand in Fig. 11.

Now the extreme end of the tail of the work, which is thus being bent about *B*, has to be rounded up as shown at *d* in Fig. 1. This is done, as shown in Fig. 11, by interposing a projection *j* on supporting lever *F*, against which the extreme end of the tail strikes as it is bent round. This, combined with the shape of the bending finger on *O*, gives the proper curve to the end of the tail.

While all this has been going on, the central wedge *R* of the punch plate has been entering between two slides *S*, spreading

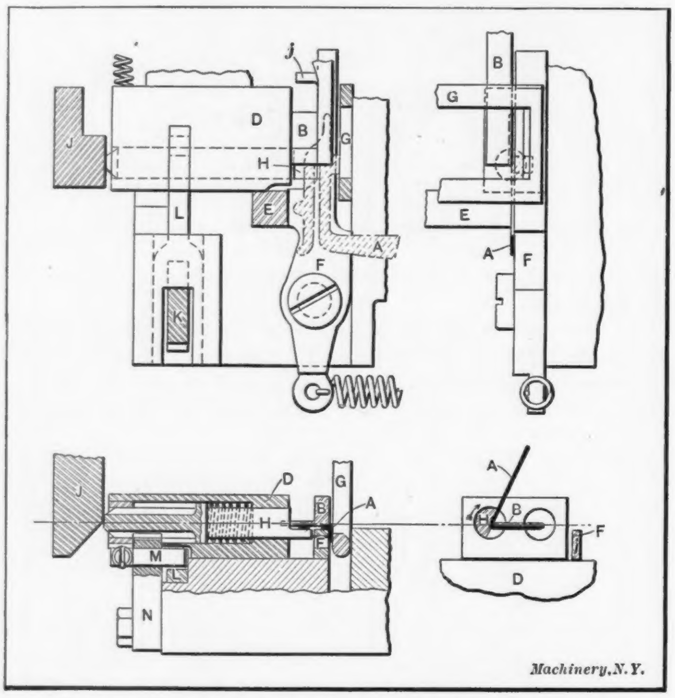


Fig. 10. Diagram showing the First Bending Operations for the Adding Machine Ribbon Fork

them apart. These slides, as shown, have projecting ends which bend the inner tab of the work (see *b*, Fig. 1) into a slot in supporting levers *F*, thus completing the double right-angle bend required at this point. The operation is shown best in Fig 11. There is a second pair of tabs on the work (*c* in Figs. 1 and 11), which has to be bent downward. This is done by punch members *T*, shown in Fig. 8, which have inclined faces pressing the tabs into bevel cuts provided to receive them in the blades of *B*.

When the operations just described are finished, punch *U* of Fig. 8 comes down solidly against the work as it lies on *V* of Fig. 9. At the same time a ledge on punch member *C* strikes solidly against the edge of the opening at *W*. Now the whole die mechanism, as so far described, is supported by a stiff rubber cushion, and when the punch holder thus solidly brings up against it, the continued movement of the ram of the press forces the whole die mechanism bodily downward against the resistance of this rubber spring. When this takes place, punch *U*, holding the work firmly against *V*, forces it down between stationary formers *Y* (see Fig. 7). This action bends up the two ears of the fork, by means of which connection is made with the operating mechanism for bringing the ribbon up in front of the type for printing. The fork is now completely formed.

On the return stroke the operations described are reversed. Wedge *R* returns as do also members *G*. The latter, it will be noted in Fig. 11, have beveled inner edges which strike corresponding wedge faces on the under sides of *S*, bringing them back to the central position shown in Fig. 9. Plungers *H* and *O* are rolled back to their normal positions and withdrawn. Supporting levers *F* are allowed to spring outward, leaving them free of tab *b*. The withdrawal of wedge *C* allows matrix fingers *B* to spring back to the central position. The work is now all bent to shape and all clear of its various supporting forms in the die and may thus be easily withdrawn.

There may be some doubt as to the advisability of making a complicated die like this one, when a number of simpler dies can be made to do the work in several operations. This matter was discussed at the time the tool was designed. It was concluded, however, that the several dies required would cost nearly as much as the complicated die, while there would

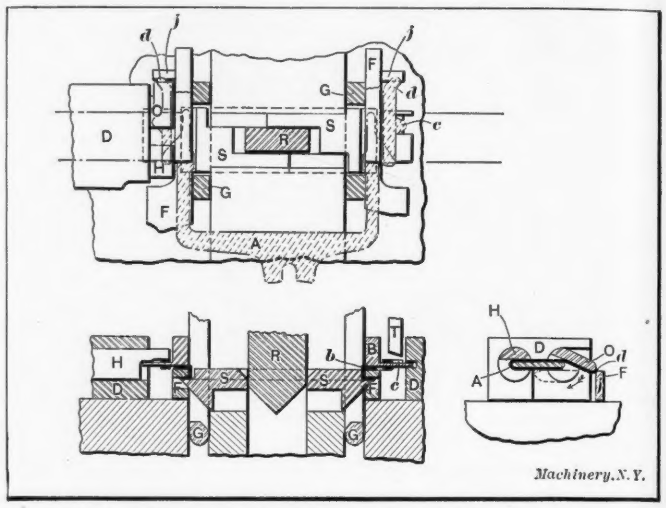


Fig. 11. Diagram showing the Completing Bending Operations for the Adding Machine Ribbon Fork

be a clear gain in the reduction of operations, consequently, of workmen's time and machine time. A tool of this kind, however, has the disadvantage of requiring careful handling. If anything should break, the whole of the bending operation is tied up instead of only part of it being disabled, as would be the case where multiple dies are used. It has never broken, however, and is turning out satisfactory work, so its expense appears to be justified by the service it is rendering.

* * *

DEATH IN UNGUARDED GEARS

Horrible accidents like this, in which limbs are mangled or lives crushed out—the direct result of unguarded gears—are of almost daily occurrence in this great country of ours where human life is held cheap—cheaper than the few pounds of cast iron that would have shielded the gears and prevented the gruesome tragedy.

Ground to Death in Gear Wheels

While Henri Koch, an engineer of a steam dredge of the R. C. Packard Co., which has been blasting and dredging in the east channel of Big Hell Gate at the foot of Ninetieth St., New York, was oiling a gear wheel near the winding drum of the dredge yesterday afternoon, his coat caught in one of the teeth and he was drawn between the largest two gear wheels. The wheels crushed through his body and then came to a stop. The engineer's screams brought half a dozen laborers employed on the dredge on the run. They saw him crushed to death between the wheels, with only his legs free of the long gear teeth. One of the laborers, Emil Hanson, tried to reverse the machinery, but the wheels would not move. After working several hours, the laborers, with the assistance of a squad of the harbor police under Lieut. Dwyer, extricated the body. It was removed to the morgue.

Must our manufacturers be brought up with a round turn by drastic laws, which awaken moral responsibility only by touching the "pocketbook nerve," before they will cease building and selling dangerous mantraps like this hoist? Some parts of machinery probably always will be dangerous of necessity, but what reason exists for leaving gears unguarded? The unguarded gear is a potential means of mutilation or death of some unfortunate, and must be abolished.

COMPRESSED AIR FOR STIFFENING BEAMS, STRUTS AND FLAT SURFACES

Prof. Perry, of the Royal College of Science, South Kensington, England, recently published a letter in which he called attention to the possibility of stiffening flexible materials by inflating them with compressed air, mentioning the bicycle tire and the long sausage-like india-rubber toy sold on the streets, as well-known examples. He suggested that the idea may be made very valuable in the design of metal structures, because with the proper internal pressure the compressive stresses can be reduced to zero. It is the compressive stresses that complicate structures and make bracing necessary that greatly increases weight. The idea, now of special interest in view of the development of the aeroplane, is treated in Perry's "Applied Mechanics" in part as follows:

"A tensile load applied to extend a beam may not only diminish the greatest compressive stress, but also the tensile stress. Again, there are many cases of beams or infinitely flat arches in which there is no tensile stress anywhere. In such cases, of course, the earth takes the necessary tensile load. When the pneumatic wheel tire was invented, Prof. Fitzgerald pointed out that columns to support loads, and military bridges easy to pack and unpack might be made of inflated tubes, the solid material being everywhere in tension . . . . . In a thin straight tube of circular section, if the greatest bending moment is M and R is the radius, t the small thickness of the material, the compressive stress anywhere due to bending is $\frac{M}{\pi R^2 t} y$, where y is the distance from the diameter which is the neutral line of the section on the compressive side. The greatest compressive stress is $M/\pi R^2 t$. Now imagine the tube to be subjected to internal fluid pressure P above that of the atmosphere; there is a tensile endlong stress $P \pi R^2 \div 2 \pi R t$ or $PR/2t$, and hence the greatest compressive stress is $M/\pi R^2 t - PR/2t$. This is just 0 when $P = 2M/\pi R^3$. The greatest tensile endlong stress is then, of course, PR/t; but this is equal to the lateral tensile stress which the mere internal pressure produces. When, therefore, the internal pressure is just sufficient to remove all compressive stress in the material, the tensile stress, where it is greatest, is the *same in all directions*, and is $2M/\pi R^2 t$. We see, therefore, that great loads may be carried by inflated tubes of thin material if they are only large enough in diameter, or by a bundle of small tubes. . . . . . One may go far in speculation on this idea—rigidity gained by using thin material and subjecting it to internal fluid pressure, so that there shall be no compressive stress. The great ships of the future may owe their stiffness and strength to the general use of fluid pressure in those parts of them where cargo is stored, and the same pressure which gives strength may serve to keep out the sea in case of a leak. It is the means by which the leaves of plants are made rigid. Similarly, large flat areas might be made of considerable size by fastening together two plane sheets by means of many connecting ties so that they may not balloon out, and then inflating them like an air cushion. Aeroplanes of sufficient size to support a man by Lilienthal's method can be made with comparatively small internal fluid pressures, and are not liable to make splinters when they fall to the ground, these splinters being a cause of considerable risk with aeroplanes made with sticks as stiffeners. Kites much larger than those suggested for military purposes might be made, in which the whole kite might be like an air cushion, or thin tubes with compressed air might take the place of the present bamboo framework. The inflation might be maintained automatically.

"Again a thin tube of radius R and thickness t has to act as a column carrying a load W, and this is the load which is carried when there is no axial tensile stress. The pressure of the fluid inside being P, we have $\pi R^2 P = W$. Also the lateral tensile stress produced in the material is PR/t or $\frac{W}{\pi R t}$, so that great loads may be supported by inflated tubes of thin material if they are large enough in diameter. Thus, for example, a tower of thin steel 1000 feet high would have in it a lateral tensile stress of only three tons to the square inch, due to its own weight and the necessary fluid pressure. Being all in tension there is no danger of instability such as exists in ordinary pillars. If large in diameter, the hemispherical top cap becomes of importance as a load. Any moderate diameter like 20 feet would bear many tons on the top in addition to the weight of the structure itself. Thus, a tower 1000 feet high and 20 feet in diameter and 0.01 foot thick would itself weigh about 125 tons. Its hemispherical cap would weigh 6.3 tons, and it would support 325 tons on its top. The internal pressure would be 23 pounds per square inch and the tensile stress 10 tons per square inch. There would be no compressive stress."

MACHINING A MOTOR FLY-WHEEL

By EDWARD J. BLANCHARD*

Much has already been written about the machining of parts of various shapes and sizes on both hand and automatic turret machines. But the machining of motor fly-wheels as they are finished on a No. 3-A Potter & Johnston automatic, will no doubt be of interest to many, especially to manufacturers of gas engines. The manufacturer of to-day realizes more and more the need of automatic turret machines, if he is to meet competition. This is particularly so with the automobile manufacturer.

The tools illustrated in this article were designed and built by the Potter & Johnston Machine Co., of Pawtucket, R. I., for a well-known automobile concern in France. These tools were designed to take in two different sizes of fly-wheels which are shown in Fig. 1, and which the reader will note are very much alike. In fact, the clutch part and the hole, which are important, are the same on both sizes. The dimensions given are in millimeters, and are the finished sizes.

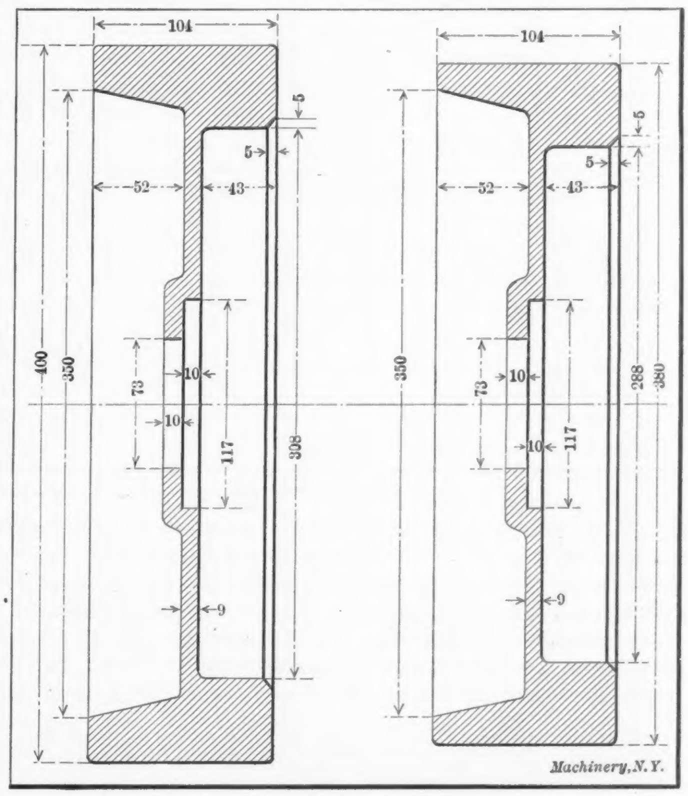


Fig. 1. Fly-wheels to be Machined

The fly-wheels are finished all over in two operations, and the time required for finishing both operations is 35 minutes. To this, however, must be added about 4 or 5 minutes for each operation, allowing time to remove the finished casting and to put in a rough one, making a total of 44 minutes in all.

First Operation

The fly-wheel is gripped under the rim by the hardened jaws A, Fig. 2, which are held in the standard chuck furnished with each machine. The chuck is of the three-jawed type and is shown at A in Fig. 3. One of the jaws is also visible at B. This chuck is operated by a socket wrench. Referring again to Fig. 2, the jaws are scored at B so as to prevent the work from slipping. It will also be noted that the flat part shown at B gives a very good bearing and proper gripping surface for the jaws. It may be necessary to call the reader's attention to the fact that this extra metal, as shown by the dotted line in the engraving, is added to the castings to facilitate handling, and is removed in the second operation. The pins C back up against the web and serve to locate the work. D is the pilot bushing which is fitted to the chuck, the tapered part E fitting into a similar taper in the chuck plate. F and G are forged tools which rough face both sides of the fly-wheel and are carried in the standard toolposts H and I on

* Address: 84 Warren Ave., Pawtucket, R. I.

the cross-slide block *J*, which is fastened to the cross-slide by means of the screw *K*. The forged tools *L* and *M*, which are similarly shaped to *F* and *G*, and are carried on the front cross-slide. They finish-face both sides of the fly-wheel, the cutting edge *N* rounding the corner. The hardened steel block *O* is fastened to the cast-iron block *P* by means of the screw *Q*, and the block *P* is fastened to the block *R*. The block *O* operates the swinging tool used for facing the web.

Fig. 3 shows the tools on the first turret face, which have just finished their work, and the turret has partly returned to the indexing point. As has been previously described, *A* is the chuck and *B* one of the jaws, *C* is a piloted boring-bar carrying the previous turret face and cutter *K* operates in the hole. As the practice was to use the same tools as far as possible in subsequent operations, this swing tool was designed to face the web in the next operation as well. The reader will see by referring to Figs. 1 and 2 that the fly-wheel has a raised part around the hole on the other side of the web. Therefore, it was necessary to have the extra slot *L* put in the swing tool. This swing tool consists of the swinging arm *N* held to the body *M* by means of stud *O*. This stud is fitted so as to allow the arm *N* to swing, and is fastened to body *M* by a nut and washer. Another one of these blocks is fastened to the swinging arm at *Q*. These blocks are also free to rotate. *R* is a

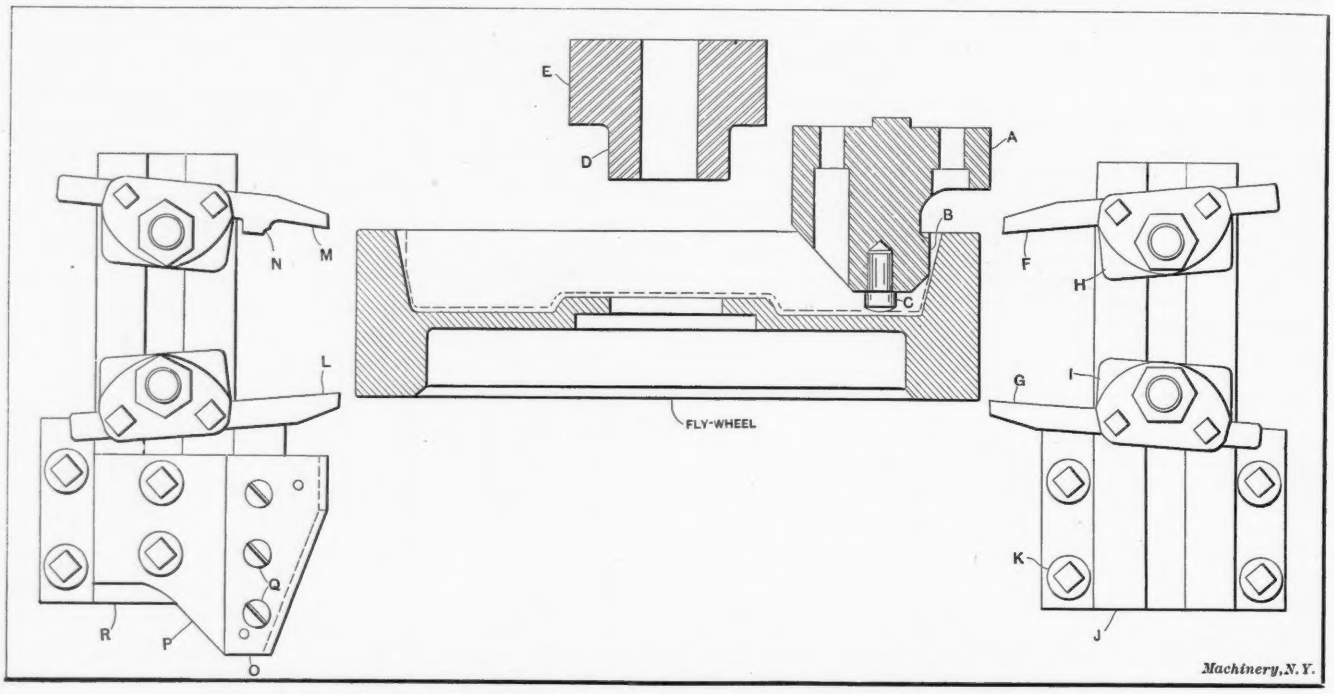


Fig. 2. Method of Chucking Fly-wheel in the First Operation and the Application of the Cross-slide Tools

two blades *D* and *E* which bore and counterbore the hole in the hub. *F* is a standard turning-tool holder carrying turning-blade *G*, which turns the periphery of the wheel. *I* is a tool which bores under the rim, and is held in the special boring-stem *H*. Another stem which cannot be seen in this photograph is used for turning a groove in the web. This groove is turned in the proper place so that tool *J*, shown spring between these two blocks, so that when the arm *N* is pushed forward the spring is compressed, and when the pressure is removed from the arm it is forced back to its starting position by this spring. *S* is a steel strap screwed on to the body. The cutters are held in place by clamps as shown at *T*, and have backing up screws which provide longitudinal adjustment. *U* is a stop-plate with an adjusting screw so as

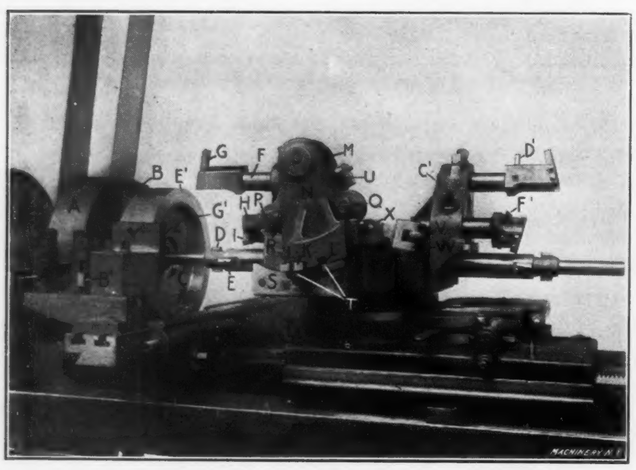


Fig. 3. Tools used in the Turret for the First Operation

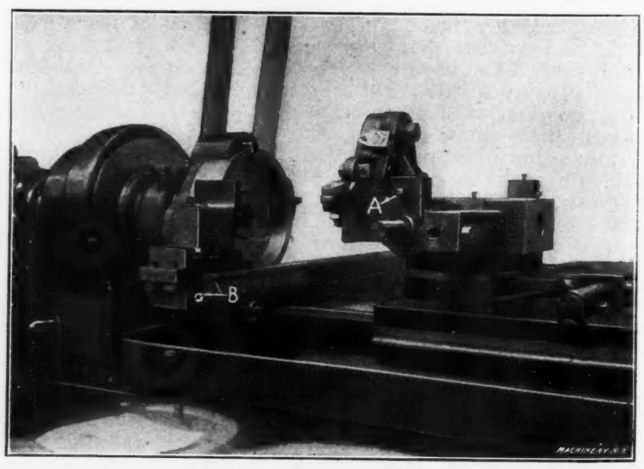


Fig. 4. Tools used in the Turret for the Second Operation

on the next turret face, can start cutting without having to break the scale. The standard turning-tool holder is shown clearly at *C'*. The rear cross-slide tools work simultaneously with the turret tools just described. The cross-slide is actuated by a separate cam on the same drum as the turret cams, and is so constructed as to permit adjusting so that the cross-slide can be fed in when desired. It will be noted that there are seven tools cutting at the same time, which is a feat that cannot be accomplished on a hand machine.

On the next turret face is shown a swing tool which faces the web. Cutter *J* starts in the groove made by the stem on to have the arm stop in the proper position. *V* is a roll held in the carrier *W*, which is pivoted at *X*, the holder for the roll being held on the turret face as shown. As has been previously explained, this swing tool is pushed by the hardened steel block *Y*, which has a groove *Z* machined in it. This groove engages roll *V*, and as the front cross-slide feeds forward to finish-face both sides of the fly-wheel and round the corner, it also pushes the swing tool. *A'* and *B'* are the forged tools which finish-face the fly-wheel and which are shown at *L* and *M* in Fig. 2.

The tools carried in holder *C'*, on the third turret face, are

the same as those on the first turret face with the exception that the pin cutter D' is added, which rounds the corner E', and blade F', which chamfers the inside edge G'. On this turret face is omitted also the tool which turns the groove in the web. On the fourth turret face, which is directly in the rear of the swing tool and which is not visible in Fig. 3, is a bar similar to the boring-bars shown on the first and third turret faces, except that it has single point cutters instead of flat cutters. This bar sizes the hole in the hub and also the counterbored recess. This completes the first operation when the machine is stopped, and the operator replaces the finished piece by a rough one, when the machine is again ready to start. The time required to finish this operation, including the time necessary to replace the finished piece by a rough one is 30 minutes, or in other words, the output for this operation is 20 fly-wheels per day of 10 hours.

Second Operation

In the second operation the fly-wheel is centralized by the bushing *A* which is clearly shown in Fig 5 and is held in the fixture on the spindle nose *B* by means of screws *C*. This centralizing bushing *A* is hardened and ground and fits the counterbored hole in the fly-wheel which was finished in the first operation. The fly-wheel is held in place by means of

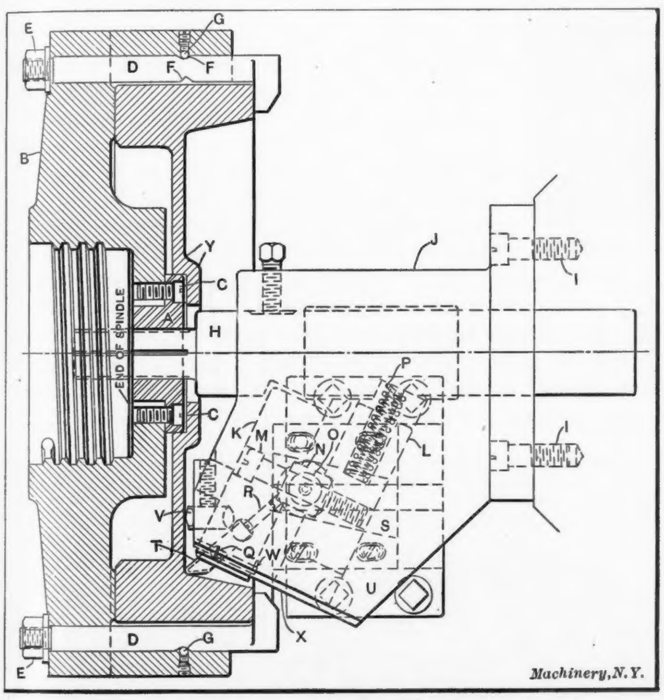


Fig. 5. Details of Chuck and Taper Boring-tool used in the Second Operation

the hook bolts *D* which clamp it against the fixture on the spindle nose as shown. There are four of these hook-bolts and they are clamped by means of the nuts *E*. Each bolt has two countersunk spots *F* diametrically opposite, as shown, so that when the operator changes the pieces the bolts are turned half way around, and the ball *G*, which has a spring at the back of it, drops into the opposite spot and keeps the hook part of the bolt out of the way. After the work is clamped in the fixture on the spindle nose the machine is started up and the taper boring-tool on the first turret face is brought into position and operates on the work. This taper boring-tool is clamped to the turret by screws *I* and is centralized by bar *H* which is also used as a pilot. The taper boring-tool consists of a cast-iron body *J* and carries two steel plungers *K* and *L*, which are hardened and ground. These plungers are clamped together by the screw *M*, and between these plungers, keeping them a certain distance apart, is a block *N*, one end of which is turned down so as to fit the roll *O*, held in place by a screw and washer. In the back of one of the plungers is a spring *P* which keeps the plungers out. One plunger would have been better and cheaper to make, but on account of the depth of the bore it was impossible to get the roll outside of the fly-wheel, when the end of the cut was reached, unless the plunger had been set at an angle which would necessarily have been too great. Plunger *K* carries a tool *T* which is held in place by screw *Q*. This tool has also a backing up screw *R* which makes it possible to get longitudinal adjustment. Roll *O* engages a slot in the hardened steel cam plate *S* which is screwed to the special cast-iron block *U* on the cross-slide. This slot is machined at an angle of 13 degrees and it can readily be seen that as the turret advances and the roll *O* engages this cam, the tool *T* will be forced to travel at the proper angle, at the same time that it is feeding in. *V* is a pin-tool set in the body of the taper boring-tool and turns a groove in the web to receive one of the cutters in the swing tool as described in the other operation. *W* is a felt washer held in place by plate *X* which also covers up the hole which was made for plunger *L*. This keeps the dust and chips from getting into the holes and eliminates a lot of trouble which is usually caused by the chips and dust getting between the sliding parts. A blade which can be seen at *A*, Fig. 4, is also carried in the body of this tool and forms the part *Y*, shown in Fig. 5. The taper boring-tool rough bores the clutch part. A tool similar to the pin-tool *V*, is carried on the third turret face and finish bores the clutch part. On the second turret face is the same swing tool which was used in the previous operation, but with the addition of an extra blade, which faces the web and raised part around the hole, the swing tool being operated in the same manner as it was in the first operation. The cam which is used on the turret face carrying the swing tool, is made so that when the turret has advanced the full amount it dwells long enough to allow the cross-slide to push the swing tool. When the tools on the first turret face begin to work the cross-slide is against the stop-screw *B* (Fig. 4) having ~~been brought~~ up previously by a special rear cross-slide cam. When the next turret face brings the swing tool in place the cross-slide starts to feed forward and pushes the swinging arm until the web is faced. Then the special rear cross-slide cam mentioned, which is a combination front return and rear dwell cam, brings the cross-slide back against the stop-screw and keeps it there until the clutch part is finished, thus assuring the correct taper. This operation consumed exactly 14 minutes, including the time necessary to take out the finished casting and to put in a rough one, or 43 fly-wheels per day of ten hours. The time given is the average time which the writer secured for his own benefit, and was made at the works of the concern for whom the tools were built, and it may be appropriate to mention at this time that the manufacturers stated that they were getting better work and more of it than they were able to get by their former method of machining. This is only one of an unlimited number of pieces which can be finished on these machines, and the reader will readily appreciate the advantage of this type of machine over the hand machine, as the only care necessary after the machines are once set up for a certain job, is to take out the finished work and to put in another piece. An operator can easily take care of from four to six machines, depending, of course, upon the length of time consumed in finishing the parts, and the manufacturer can also depend on each piece being a duplicate of the other.

* * *

UTILIZATION OF SCRAP

There is in Cleveland a concern that makes a business of blanking metal for other firms that do stamping. Now anybody who knows anything about the stamping business knows that there are hundreds of jobs a year which leave scrap from which many other stampings could be made—if the firm happened to get the order for the smaller pieces. But it may not get such an order for months and to store the scrap from the first job until the second comes, would cost more than buying new sheets for the second. But suppose somebody could make a business that did nothing but blank, suppose somebody could go to a lot of other stamping concerns and get their blanking work? The variety of pieces for which many concerns had orders would be such that the blanking concern could often use scrap twice or three times. The Cleveland man who started the blanking business got the idea by simply asking himself, "Why cannot better use be made of scrap steel than selling for scrap?"—*Silent Partner.*

EXAMPLES OF MODERN TURNING PRACTICE IN AUTOMOBILE CONSTRUCTION

A number of interesting examples of what can be accomplished with a modern turning lathe that has been specially designed for the rapid and accurate production of work, are shown by the illustrations accompanying this article. The operations on the different pieces illustrated are particularly noteworthy, partly because of the limited time in which the work is accomplished, and also because of the accuracy with which certain of the surfaces have to be finished.

The camshaft shown in the machine in Figs. 1 and 2 is a good example of that class of work in which rapidity and precision are combined, as seventy-five of these shafts are turned in ten hours, and the diameter *d* and the length of the bearing *l* must be kept within limits of 0.001 and 0.002 inch, respectively. This work, as well as the other operations which will be subsequently referred to in this article, is performed on the well-known Lo swing lathe, built by the Fitchburg Machine Works, of Fitchburg, Mass.

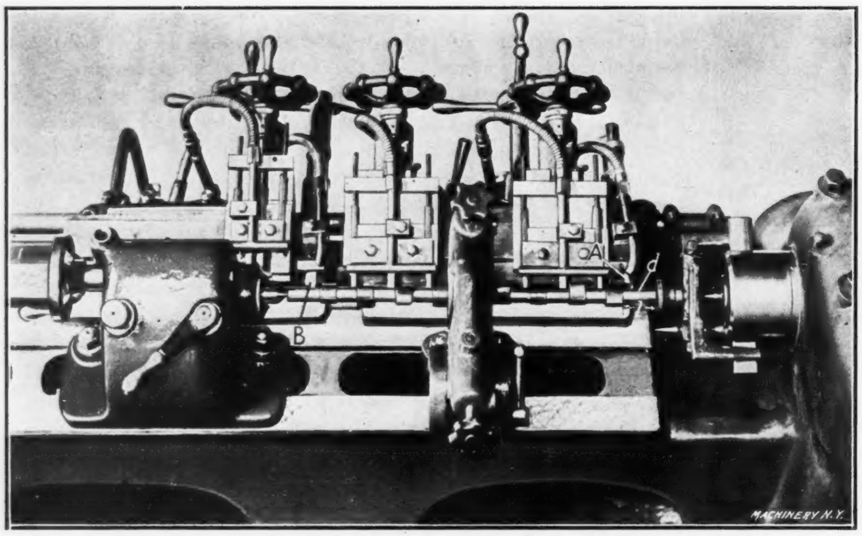


Fig. 1. Rear View of a Lo-swing Lathe arranged for Turning Camshafts—First Operation

These shafts are finished in two operations. The arrangement of the tools for the first operation is shown in Fig. 1, while Fig. 2 shows the machine set up for the second or final operation. Owing to the rapidity with which this work is turned out, a somewhat detailed account of the successive steps will be given. As it is necessary to support the shafts while they are being turned, they are first rough-ground on the central bearing for a steadyrest. The shaft is then placed in the lathe and the tool *A*, that is used for turning bearing *d*, is then used as an indicator for locating the automatic stop-rod.

As those familiar with the Lo-swing lathe know, this automatic stop-rod is located at the front of the machine and contains a number of adjustable stops which can be set to automatically disengage the feed at any predetermined point. The rod itself is also adjustable longitudinally so that the tools, which, for a given piece of work would have the same total travel, can be disengaged at a point nearer or farther from the headstock as may be required.

The method of using the tool for locating the stop-rod is as follows: After the stops on the rod have been set to give the required amount of tool travel and in the approximate location with reference to the work, the carriage is brought against the stop that is set for that side of the end cam which is next to bearing *d*. The stop-rod is then adjusted just far enough back to allow the tool to clean up the side of the cam. As soon as the cam is faced, the carriage is fed to the second stop and the inside of the collar for bearing *d* is finished. By the use of the stops, the distance between the cam and collar is kept within a limit of 0.002 inch. The tool is next returned to its first position, and, after being fed in until a zero mark on the micrometer collar of the feed screw is reached, it is again passed over the work, thus finishing the bearing within a limit of 0.001 inch. These close limits are necessary, as the jig used for drilling holes through the collar is clamped to and located by this finished bearing.

The two three-tool attachments which are both mounted on one carriage, as shown, are next employed for rough turning, simultaneously, the six spaces between the cams. The bearing on the tailstock end of the shaft is then rough turned by tool *B*, the stop for which is adjusted to face the cam the right length from the end of the shaft. This finishes the first operation which consumes five minutes.

After the entire lot is machined in this way, the tool is changed as shown in Fig. 2 for the second operation—except when two lathes are employed, in which case the work is, of course, passed from one to the other. On the second operation, the shaft is reversed, the dog being placed on the finished end. The stop-rod is first set for facing the collar to the correct width. This is done by running the carriage against a stop—set approximately correct—and adjusting the automatic stop-rod until the tool which faces this shoulder just touches the blade of a small combination square, set to project ¼ inch (the thickness of the collar) beyond the base of the square, which is held against the finished face of the collar. When this adjustment has been made, the four sizes on this end, including the turning of the collar itself to the right diameter, are finished simultaneously by the special four-tool attachment shown. The tools in this holder are set the right distance apart for forming the shoulders, and any change of diameter is obtained by the screws shown back of each tool, which give an independent adjustment. All of the bearings are turned with an allowance for grinding, which operation is performed after the shafts are carbonized and hardened. The time required for the second operation is two minutes.

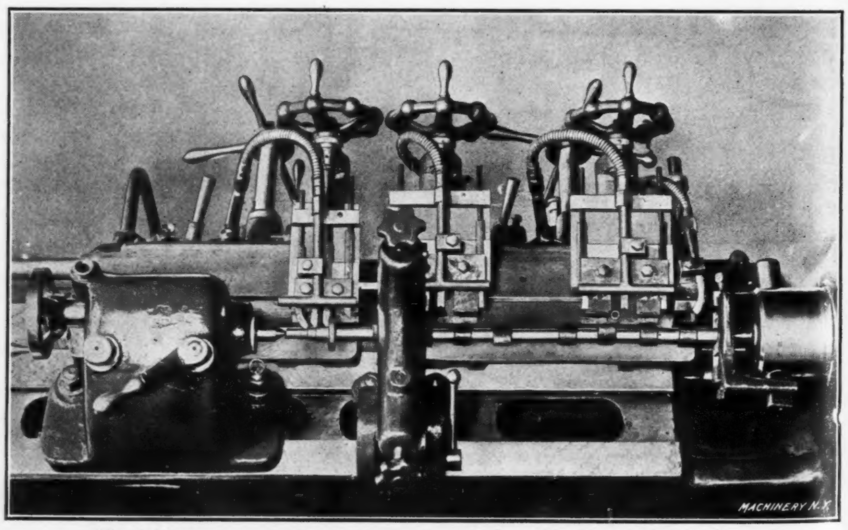


Fig. 2. Arrangement of Tools for the Second Operation on the Camshafts

It will be noted that provision is made for supplying a cooling compound to the cutting edges of all tools, each of the three tool-blocks having a T-headed pipe which distributes the lubricant. These pipes or nozzles are connected by the flexible metallic hose shown, to a cored passage in the carriage which is supplied from a geared pump inside the head of the machine. The speed of rotation, while turning, is 375 revolutions per minute, and the feed rate is equivalent to 1 inch of tool travel for every 75 revolutions per minute of the work. By means of a speed variator on the headstock, feed changes can be conveniently made. These shafts are being finished by the thousands in the time specified.

The part illustrated in Figs. 3 and 4 is an automobile transmission or propeller shaft. In this particular case, it is the nature of the work which makes the turning operation one of interest, as cylindrical, tapering, and spherical surfaces are finished almost as easily as a piece of uniform diameter. Fig. 3 shows, diagrammatically, the arrangement of the tools and work for the first operation. After the shaft is "spotted" at *A* for the steadyrest, the straight part *C* and the collar *B* are sized with tools *S* and *R*, which are mounted on the left-hand carriage. A concave groove is then cut in collar *B* by tool *R*,

The method of driving this shaft is worthy of note as it is both simple and ingenious. A dog having two driving arms is used, each of which bears against a pin *N* that passes through a hole in the spindle. As the ends of this pin, against which the dog bears, are beveled in opposite directions, the pin turns in its hole when the dog makes contact with it and automatically adjusts itself against the two driving members of the dog. The advantage of driving by a two-tailed dog, as most mechanics know, is in equalizing the tendency to spring slender parts while they are being turned.

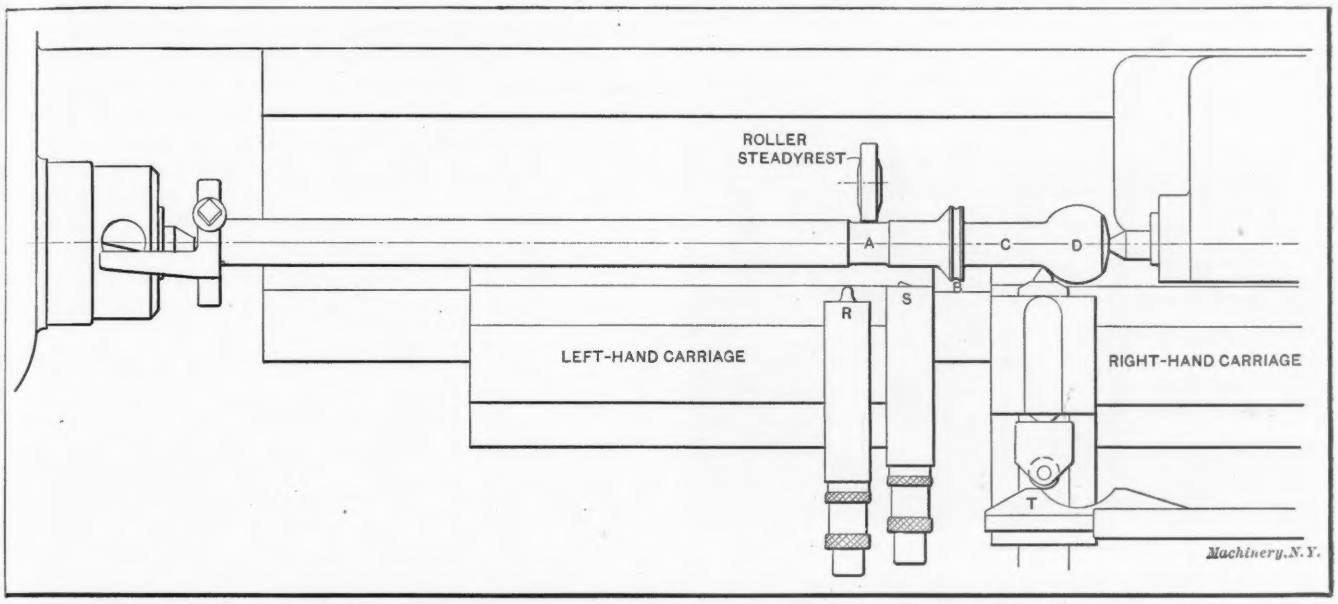


Fig. 3. Diagrammatical View showing Tools and Spherical Turning Attachment used in Machining Automobile Propeller Shafts

after which spherical end *D* is formed by a special attachment mounted on the right-hand carriage. This attachment is the same in principle as the regular taper turning attachment, the substitution of a circular templet *T* for the straight kind used on taper work, being the only practical difference. It

It should be added that the equalizing driver referred to is the one regularly employed on the Lo-swing lathe.

An excellent example of fast but accurate work is shown set up in the machine in Fig. 5. This part is an automobile steering knuckle, the shape of which is more clearly shown

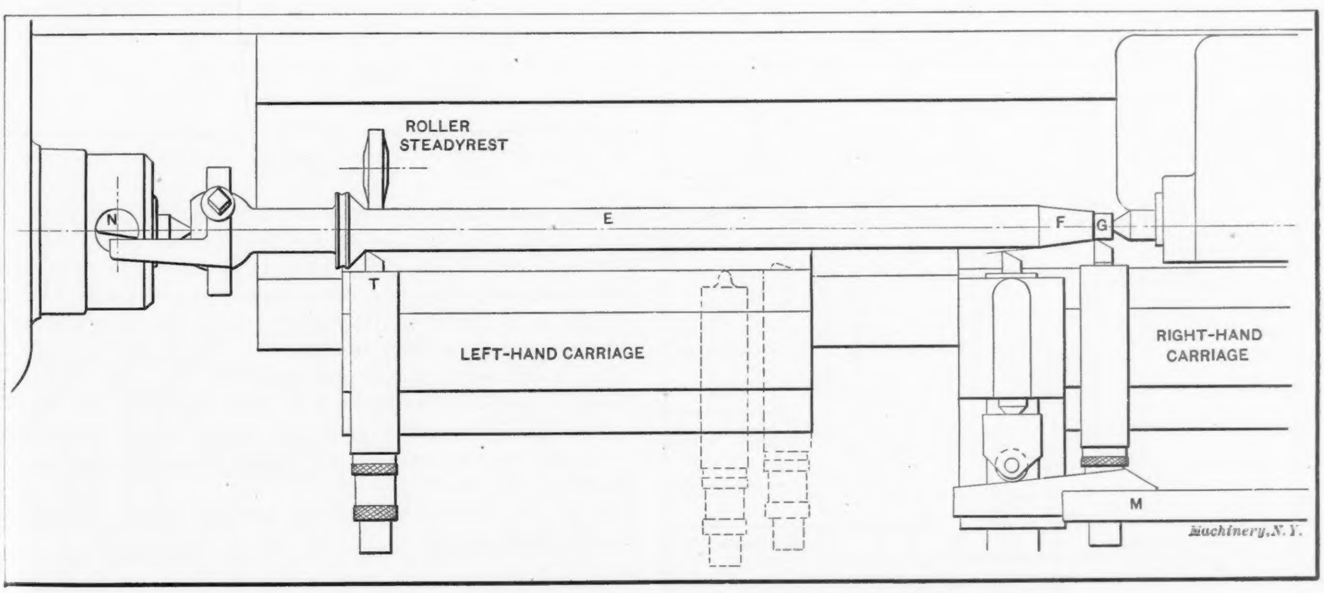


Fig. 4. Tool Arrangement for Second Operation on Propeller Shafts

was necessary to have this ball-shaped end true within 0.001 inch, which accuracy has been easily obtained.

After the surfaces mentioned have been finished on the required number of pieces, the work is reversed and the tools changed as shown in Fig. 4. The first step in the second operation is to turn the body *E* of the shaft with the tool *T* on the left-hand carriage. The taper *F* and the straight part *G* are then finished, which completes the turning. It will be noted that in setting up the machine for this second operation, it is arranged for taper turning by simply replacing the circular templet with the straight one shown. When this taper attachment is not in use, the swiveling arm *M*, which is attached to a bracket, is swung out of the way.

in Fig. 6, which also indicates the arrangement of the four tools used. This part, like those previously referred to, is finished in two operations. The tool setting is identical for each operation, however, except for diameter adjustments. As the illustration shows, three of the four tools employed are used for straight turning on different diameters, while the fourth finishes the taper. These pieces, which are rough drop forgings, are first reduced to the approximate size. When it becomes necessary to grind the tools, they are reset and those parts which have been roughed out are turned to the finished size. During both the roughing and finishing operations, the work revolves at a speed of 375 revolutions per minute. The feed for roughing is equivalent to 50 revolu-

tions per inch of tool travel, while for finishing it is reduced, the work making 100 revolutions per inch of travel. By finishing in this way, it has been possible to maintain the size of the straight portion at the large end of the taper within 0.0005 inch. The average time for the first operation, which includes starting, stopping, turning and replacing the piece, is one minute, while for the second operation with the finer feed, an average time of two minutes is required.

The work is driven by sleeve *S*, which fits over the spindle and is held in position by the regular driver, as shown. This sleeve is notched to fit the knuckle, so that the latter can be

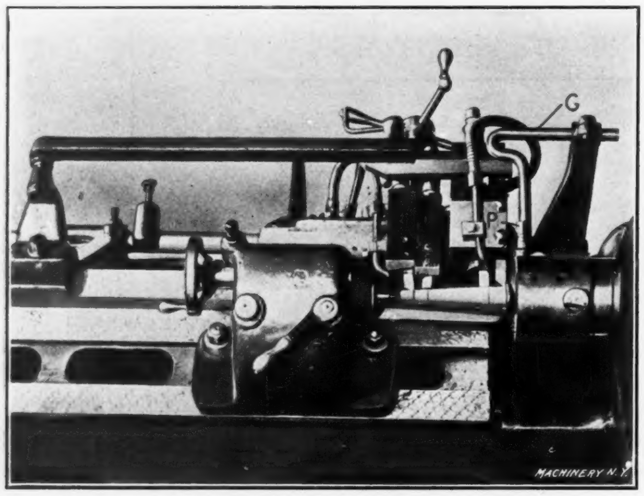


Fig. 5. Lo-swing Lathe set up for Turning a Steering Knuckle

easily and quickly replaced when finished. One of the interesting features of this job lies in the method of locating the shoulders on each knuckle at the same distance from the hole *H* which is drilled previously, and which receives the bolt on which the knuckle swivels when assembled in a car. As soon as the knuckle has been placed between the centers, a close-fitting plug *P*, Fig. 5, is inserted in this hole and the

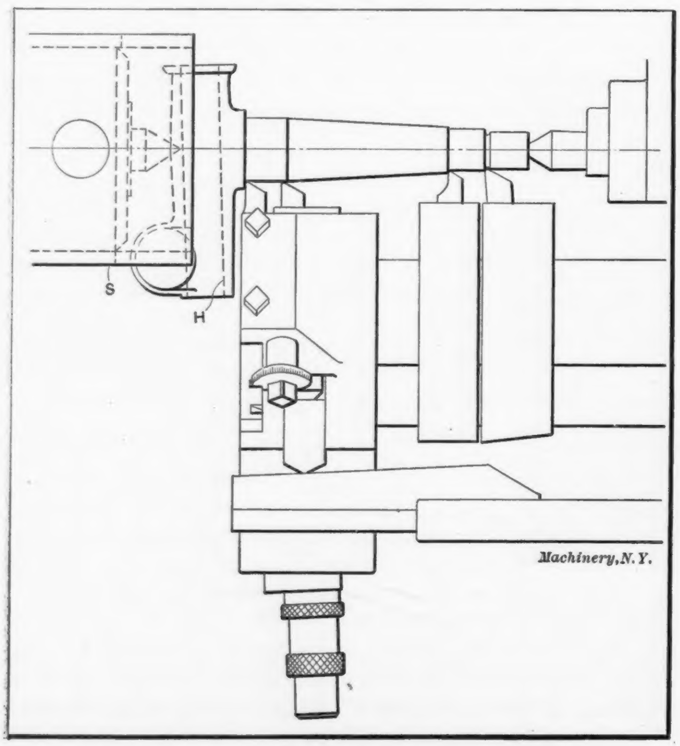


Fig. 6. Plan View showing Method of Driving Steering Knuckle, and Tooling

indicator arm with its attached gage or caliper *G*, is swung up to the position shown. The stop-rod on which the stops have been previously set for the correct distance between the shoulders, is next adjusted axially until the gage *G* just touches the plug *P*. The indicator is then swung out of the way, and the piece turned. If the next knuckle were centered, say deeper than the previous one, which would, of course, cause it to be located near the headstock, obviously all the shoulders would be located farther from the finished hole, providing the position of the stops remained the same as before. In such a case their position would, however, be changed by shifting the stop-rod until the gage *G* again touched the plug, thus locating all the stops with reference to the hole. As the adjustment of the stop-rod changes the position of the taper templet as well as the stops, it is evident that both the shoulders and the taper are finished the same distance from the hole in each case. The connection of the bracket (to which the templet arm is attached) with the stop-rod is clearly shown in Fig. 5; this bracket can be locked to the ways or adjusted to slide when the stop-rod is moved.

In Fig. 7 another turning operation is shown, the work in this case being a rear axle for a motor truck. The turning of this part is a good example of that class of work where the rapid removal of superfluous metal is the important feature. As the engraving shows, the stock prior to turning is 3½ inches in diameter and it is reduced to a minimum diameter of 1 1/16 inch. This metal is turned off with one traverse of the carriage or by one passage of the five tools, and the weight of the chips removed from each end of the axle is approximately twelve pounds. The time required for the actual

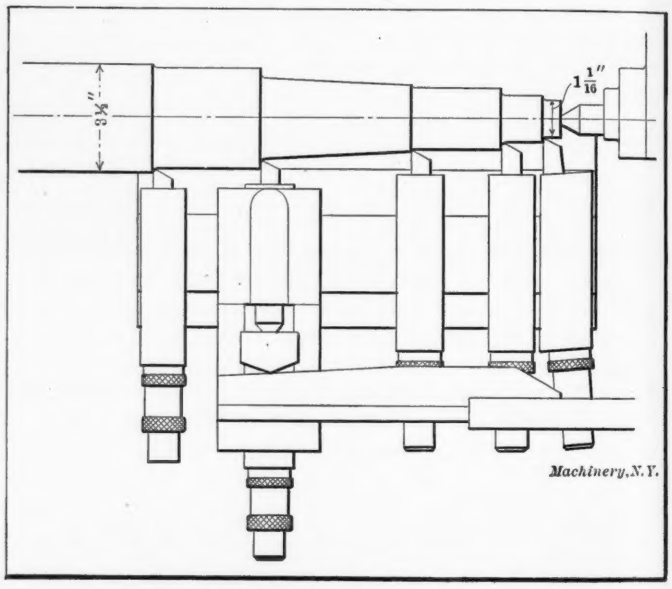


Fig. 7. Axle End which was reduced, as shown, in One Traverse of the Five Tools

turning is about 9 minutes, while the total time for the operation, which includes placing the heavy piece in the machine, turning, and removing the work to the floor, is 12 minutes. The work revolves while being turned at 110 revolutions per minute, and a feed equivalent to 1 inch of tool travel to 60 revolutions of the work is used. It will be noticed that the taper attachment is also employed on this part, the taper being turned by the second tool from the left. As the axle is equipped with roller bearings, it was found desirable to finish the bearing part by a separate operation, therefore, in the operation shown the axle is simply roughed down rather close to the finished dimensions, leaving enough material for a light finishing cut.

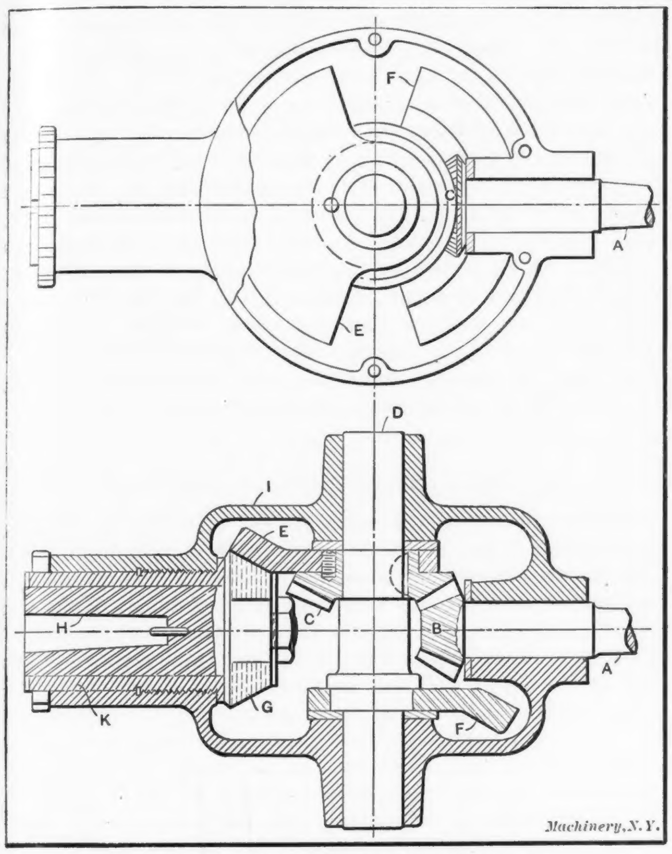
* * *

The aeroplane industry has developed in France with as much rapidity as the manufacture of automobiles in the beginning of that industry. A little over a year ago there were less than 100 aeroplanes in all Europe, principally in France. Statistics show that since the first cross-channel flight, Bleriot has built 250 machines, duplicates of the machine in which he crossed from Calais to Dover, and Farman has built at his works over 100 biplanes. The machines built by other makers bring the French production to over 800 which have sold for something over $2,500,000. The small Bleriot monoplane sold at first for $2000, but after its success in crossing the English channel, the price was raised and the latest type now costs from $3100 to $5100; the price of the Farman machine is $5600; Voison, $4600; Antoinette, $500; Wright, $5000; and Sommer, $5000.

A TOOL FOR GRINDING IN GAS-ENGINE VALVES

By ARTHUR C. PLETZ*

As the manufacturing of gasoline engines is becoming a great factor among American industries, many a superintendent, foreman and draftsman is putting in hard days of



Efficient Tool for Grinding in Gas-engine Valves

work racking his brains for new ideas in tools which will help toward increasing the output and keep up with the present demand. Among the many tools that have been designed and tried out I think the valve-grinding tool is quite important. Many different designs of these tools have been tried with more or less success. Some superintendents still cling to the hand method, as they think it is the most satisfactory. The writer has tried several methods, and the accompanying illustration shows a tool which gives satisfactory results.

The driving end of this tool is made with a No. 1 Morse taper, thus making it interchangeable with any light drill press. The reciprocating motion is obtained in the following manner: Driving shaft *A* has a bevel pinion *B* on one end. This pinion drives bevel gear *C* on shaft *D*, which carries two segments *E* and *F*. These segments are of the friction gear type, and engage alternately with rawhide or fiber reciprocating pinion *G*, which revolves about one and three-quarter turn in each direction. Spindle *H* runs in the bronze bushing *K*, and is arranged to adjust pinion *G* so that it will bear tightly enough against the driving segments to drive the valve. Pinion *G* has a No. 1 Morse taper, thus enabling it to take any style of tool to drive the valve. The case *I* is made from a thin aluminum shell, which reduces the weight considerably.

* Address: Swift Auto Co., Detroit, Mich.

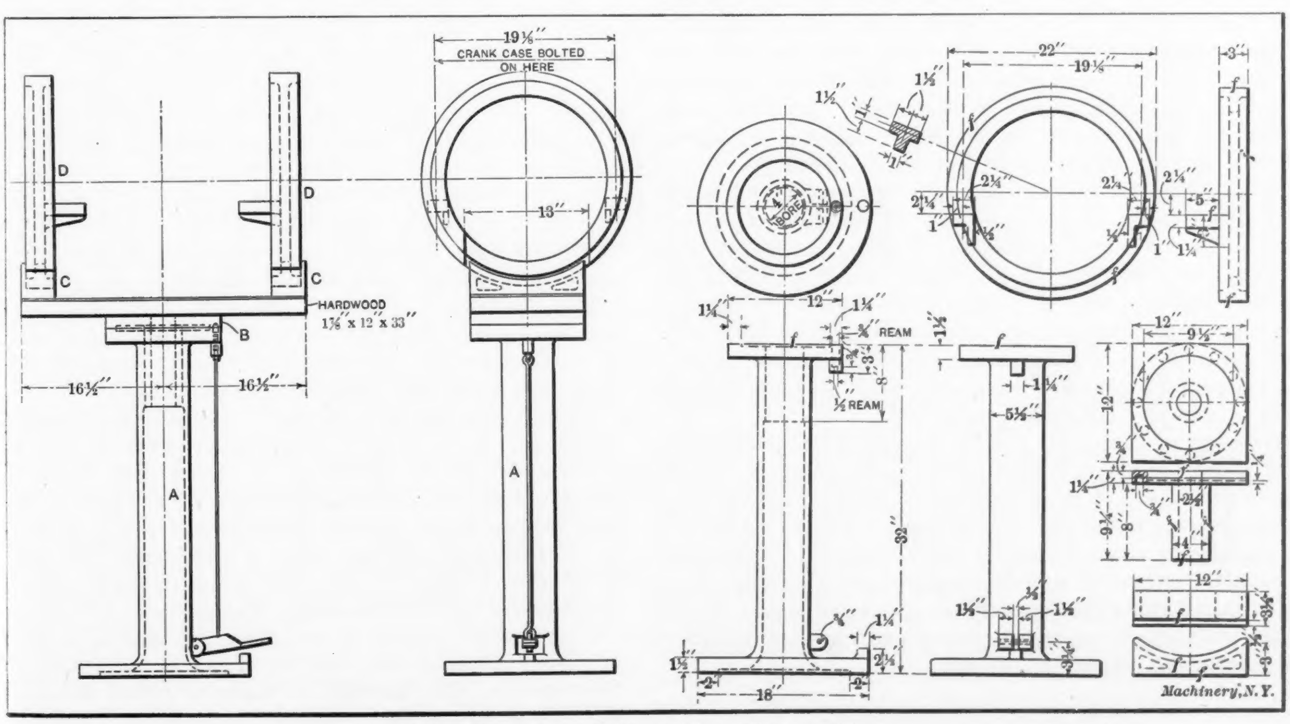
* * *

MOTOR ASSEMBLING STAND

By JIG AND TOOL DESIGNER

In a well-equipped shop, where several thousand automobile motors were being manufactured, a convenient assembling stand was necessary and the design shown in the accompanying illustration was made. There are several different styles of these stands on the market, and besides, almost every factory has a design of its own. The particular design illustrated is not entirely original, as some of the points in different types now being used in other factories are combined in this one; in fact, practically all the good points of other types are here combined, with a few new and original ideas, thus making this stand very convenient and satisfactory.

The engraving shows the stand assembled and in detail. It is composed of a column or base *A*, to the top of which is fitted a trunnion *B*, that may be swiveled about a vertical axis. Bolted to the top of this trunnion is a hard wood plank, at the ends of which are fastened shoes *C*, which fit the rings *D* that support the motor being assembled. These rings have the same radius as the shoes in which they rest, and they are provided with projecting brackets to which the motor crankcase feet are attached. By referring to the detail of the trunnion *B*, it will be seen that 12 holes are drilled in its under side. These are used for locking the plate by means of the foot lever and spring plunger shown in the assembled view. This indexing arrangement makes it possible to swing the motor around to the most convenient position for the workman. With a well-balanced motor, no matter what the weight, the finished supporting rings and the shoes in which they rest, furnish just enough friction to give a firm but even hold so that the motor, besides being sprung about a vertical axis, may also be turned over to the most convenient angle.



Adjustable Stand for Holding Motors while Assembling

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MACHINERY

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MACHINERY is published in four editions. The practical work of the shop is thoroughly covered in the Shop Edition, $1.00 a year, which comprises approximately 700 reading pages and 36 Shop Operation Sheets, containing step-by-step illustrated directions for performing 36 different shop operations. The Engineering Edition—$2.00 a year, coated paper $2.50—contains all the matter in the Shop Edition, including Shop Operation Sheets, about 300 pages a year of additional matter and forty-eight 6 x 9 Data Sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, $3.00 a year, comprises the same matter as the Engineering. The Railway Edition, $2.00 a year, is a special edition including a variety of matter for railway shop work—same size as Engineering and same number of Data Sheets.

INFLUENCE OF THE AUTOMOBILE

Forty or fifty years hence historians probably will refer to the marked influence that the automobile had on the life and trend of thought of the American people during the latter part of the nineteenth and first part of the twentieth centuries. Even we, living in the midst of the age of transition, are struck with wonder at the great change in traffic plainly observable on the streets of any large town. Ten years ago, even five years ago, the horse-drawn vehicle was the common individual means of conveyance in New York, Chicago, and other cities. To-day the auto taxicab preponderates, and the number of motor trucks in use is large and rapidly increasing.

But of even greater significance is the conversation of people operating, owning, or hoping to own automobiles. Their conversation abounds in references to cylinders, carburetors, magnetos, differentials, gaskets, lubricators, horsepower, and hundreds of other mechanical terms almost unknown to the mass but a few years ago. Not only do men talk thus, but women converse animatedly about things purely mechanical, displaying knowledge amazing to those accustomed to think that they have no capacity for such matters.

The effect of familiarity of a large class of intelligent people with the operation and details of a rather complex machine whose parts have to be adjusted with skill must be to make them more interested generally in machinery and motors, and to concentrate more minds on improvements of importance. It should also tend to stimulate manufacturing through awakening in individuals a taste for mechanics and comprehension of the basic principles, and thus give a still greater impetus to the mechanical progress of the age.

* * *

BAD OFFICE SYSTEM

It is a bad office system in a manufacturing business that does not provide means for keeping track of responsible officers whose duties often call them into the factory. The public doing business with the members of a concern has a right to expect that the time of salesmen and others shall not be wasted in vainly waiting for some one to turn up with whom they may hope to do business. When a person calls to see the president, superintendent or buyer he should be told at once if possible where the desired party is, if not in the office, and if an appointment can be made. In the event of making an appointment he should be told what the probable time of waiting will be.

In the management of some concerns it seems to be the custom to let the officials chase about the works and show up at the office when they please. No one ever seems to know where they are or when they will be accessible. The salesman may either take a chance on a long wait, or leave and call again and perhaps repeat the experience. The philosophy of factory office management would seem to the unprejudiced observer to be summed up in the paraphrase of the golden rule, "Hand out to others what you would like handed out to you." Remember when you are tempted to let some unwelcome visitor cool his heels for an hour or two in the ante-room, and then give him a curt dismissal, that you and your representatives are likely to receive similar treatment when suppliants at the doors of other concerns. Politeness and courtesy beget considerate treatment and are well worth while as part of a policy of "enlightened selfishness."

* * *

A PROBLEM IN SHOP ECONOMY

One of the most difficult problems with which the shop manager must grapple is that of determining when to replace old types of machinery with new. Judging from statements sometimes seen in the daily and semi-technical press, one would think that engineers in general consider it economical to throw out an old machine and install a new one if it can merely be shown that the new machine will perform a certain operation at less cost than the old one. This, however, is not the only consideration. If the old machine is still in good condition and can be used for several years without any additional capital outlay, then it might prove advantageous to retain it, even though the cost per piece were slightly higher than on the new machine.

If the same operation is performed throughout the greater part of the year, and if it is possible to determine the exact reduction in cost of output by the new machine in comparison with the old one, the problem would be one of simple arithmetic, as the only factors to be taken into consideration would be the number of pieces to be made per year and the additional interest charges on the capital invested in the new machine. In most cases, however, the problem is not so simple. The machine is not used for making the same parts throughout the year, but is changed from one class of work to another. For some work the new machine may not be more economical than the old one—for other work, the economy may be very marked. Exact comparisons are then impracticable, and keen judgment, rather than calculation, is required on the part of the shop manager. Should he decide to install the new machine, and sell the old one for junk, merely because some particular piece for which the new machine is especially well adapted can be made with marked economy, he may make a mistake and incur considerable loss.

On the other hand, it is likely that a greater number of people err on the side of keeping old, worn-out machinery when a new equipment would cut down their costs. Especially is this true of long-established firms whose reputation and well-cultivated markets make them feel the keenness of competition less severely. It is a well-known fact that the most modern machinery is often found in the smaller, comparatively inconspicuous shops. The retention of old machinery long after its term of usefulness has expired is probably a greater mistake than that of scrapping tools and devices prematurely. The question of when to install new machinery and scrap the old equipment is, therefore, one that calls for better judgment of the requirements of shop practice than almost any other the shop manager has to consider. In order to decide it successfully, a comparative study of the capacities of new and old machines extending over long periods of time is often necessary. In that way only is it possible to decide with reasonable accuracy whether it be more economical to retain old equipment or to install new.

CAPACITY OF HIGH-SPEED STEELS

During the last decade high-speed steel has been developed from a product popularly regarded as a metallurgical curiosity to a cutting material that has largely displaced carbon steel in most up-to-date and progressive machine shops. It is saying only what every mechanic knows to be a fact to state that high-speed steel has worked a tremendous change in speeds and feeds and in the design of machine tools; also that the quality of high-speed steel has been greatly improved.

In the early years of high-speed steel history, there were all grades ranging from very good to very bad. Certain brands came to the front because of uniformity and general superiority. The situation to-day is that practically all the recognized brands of high-speed steel are good, but this does not mean that they are all alike. Far from it. The reason one brand of steel is found superior to others in a certain shop is that it has certain peculiarities of temper, speed, capacity, etc., which the men in that shop have recognized and to which they have adapted themselves and their machines; consequently the steel stands up and does good work. Another brand of steel equally good, but requiring different heat treatment or different regulations of speeds and feeds would be found far inferior in that shop because it would be treated and used as was the first steel.

The situation seems to be that each steel, when treated and used in accordance with its peculiarities, will do about as much work as any other good brand. This we have on the word of a well-known engineer who has assisted in making thousands of tests of high-speed steels. This brings us to the matter of making high-speed steel tests, on the results of which many concerns have pinned their faith. There are shops which have made extensive tests of high-speed steel and wasted many dollars in the experiments. It is a huge job to properly test a high-speed steel, and few engineers have the experience and qualifications for such important work. Very small differences in speeds, feeds, heat treatment, etc., will make almost unbelievable differences in results. Tests conducted seemingly with the utmost impartiality may be thoroughly unreliable because certain factors have not been recognized or the effect of slight variations in materials, etc., has been ignored.

* * *

READINESS TO SHOULDER RESPONSIBILITY

What is the secret of the startling and rapid rise to responsibility and power of the world's successful men? Impartial investigation shows almost invariably that it is in their readiness and willingness to accept responsibility; but especially in their *readiness*. The career of almost any successful man shows that he had prepared himself long before for the crisis he might have to meet, for the problems he might have to solve; and had trained himself for work he would surely have to do if his opportunities came. This explains simply enough why it is that men whose names become widely known for successful achievement are found equal to the difficulties that arise—they are *prepared*.

While it is true that undue influence sometimes aids in the promotion of a man, only thoughtless men would ascribe advancement in general to "pull" or "luck." As a rule, the secret of success of most men engaged in mechanical work, is that they were ready with knowledge and skill at the moment when these were demanded. The man picked for promotion is not the man who says, "I will get ready," but the man who can say, "I *am* ready." No man can prepare himself for a position of real responsibility in a week, or a month, or perhaps even in a year.

The men who now occupy leading places in the mechanical world began to qualify themselves in their early years. Those that will occupy these places ten, fifteen or twenty years hence are now fitting themselves by study and observation, and by practical training for the responsible work to come in later years. It is the apprentice who by evening study qualifies himself for the first simple duties of the drafting-room that is picked for further training when a vacancy occurs. It is the machinist who has prepared himself, who is ready for more exacting duties, that is made foreman of the new department. It is the foreman who has fitted himself for larger and greater responsibilities who becomes superintendent of the new shop; and when the "old man" retires it is the trained and prepared superintendent that is made manager. In every field of endeavor, and on every rung of the ladder, it is the man who is ready—who is prepared—that is promoted.

* * *

THE DEVELOPMENT OF MACHINIST APPRENTICES*

By F. W. SEBELIN†

The question of developing machinist apprentices seems to be uppermost in the minds of many employers, and it is gratifying to note that the superintendents and foremen in many factories are also awakening to the crying need of more learners of the trade. But it needs a united action on the part of employers to adopt a system that shall be as nearly uniform as possible.

The rate of wages should be regulated according to the class of work that each shop is equipped for. For instance, a higher rate of pay should be given in a shop where the work is rough, because it requires less instruction to produce the same result financially in a shorter time than where the work is fine, necessitating a careful and painstaking training. If the same rate of remuneration were offered by all classes of shops it would have a tendency to attract the boys to the shops doing the finer grade of work, which would place the other shop doing the rougher work at a decided disadvantage.

The boys should be placed where they are best adapted. The average boy does not know his own capacity well enough and needs the guidance of men who have been "up against it."

The importance of the machinists' trade has been greatly underestimated, due no doubt to the degrading influence of a floating element which one sees in our shops, who are not even fair mechanics, but are classed as machinists. The word "machinist" is too freely used by men, every machine hand or man who can operate a power hack-saw or cutting-off machine is classed as machinist, by those who do not know the definition of a machinist. Is it any wonder that the average American boy of fair education shudders at the thought of associating himself with such cheap help? He does not know any better.

Manufacturers should at all times be in close touch with the schools, especially the high schools and technical schools in order to encourage the boys who are interested in the mechanical trades. Invitations should be extended to the boys to visit the factories at stated times under the guidance of capable men, those especially who are interested in the boys, thereby assisting many of them to choose their future vocations and helping manufacturers in securing the right talent for their future superintendents and foremen. A boy's worth should not be considered only by the dollars and cents that he may earn for others, but also by the good that he may do for the world at large.

The automobile industry has opened up a new avenue for mechanics, and has proved a veritable gold mine for vast numbers of men. Good workmen are picked as foremen and superintendents, causing a shortage that has played havoc with the machine tool builders. The automobile industry is but in its infancy, and more mechanics will be needed as the business increases, consequently the opportunities for good men will be better than ever before—more hard luck for the other fellow who does not take time by the forelock and fortify himself before it is too late.

I dare say much of the fault lies with superintendents and foremen because more boys are not being developed in our shops. They do not want to bother with apprentices, because (as one frequently hears) the boy will not remain long enough to repay the boss something on the investment; he suddenly

* For previous articles on apprentices, apprenticeship, and apprentice conditions see: "Gould & Eberhardt's Apprenticeship System," July, 1910; "Apprenticeship Certificate," May, 1910; "United Shoe Machinery Co.'s Apprentice School," February, 1910; "Apprenticeship Conditions," January, 1910; "Need of a Good Apprenticeship System," January, 1910; "The Apprentice Problem," April, 1909; "Instruction of Apprentices in the Cincinnati Milling Machine Shops," December, 1908, and the previous articles there referred to.

† Address: 7022 Quimby Ave., Cleveland, Ohio.

vanishes, someone having offered the partly developed boy a little more pay.

But a remedy can and must be applied to stop this traffic which is filling our shops with undesirable men. There should be a uniform apprentice system established in all shops where apprentices can be used. Each employer should respect the rights of his competitors and not hire an apprentice who severs his connection from his former employers unless he agrees to work out the unexpired term of his apprenticeship with the second employer. This would benefit not only the employer, but the boy himself, because it would be the means of making him independent and a better citizen. These reforms cannot be brought about unless the shop's environment and surroundings are of such a nature as will attract a better class of boys than is usually found in them.

There should be perfect harmony between foremen and apprentices, and the boys should not be treated as if they were in the way. On the contrary, they should be made to understand that they are producers the day they enter the shop, and they will soon feel that they are of some use after all. Much depends upon the personality of the foremen to encourage the boys.

There are many shops where there are no apprentices, their managers arguing that their production would suffer if apprentices were employed, but that is a mistake. I can cite instances which have come under my own charge where I was, until recently, general foreman of the Cleveland Twist Drill Co. We had many boys working as apprentices, and some who were in their third year were on a par with the best journeymen we had in the shop, and their knowledge was not limited to any particular branch. These same boys were used as instructors to those who followed them, because our ideas and methods were so thoroughly inculcated in them that we could safely use them as instructors to hand down their experience to others. Every man in the shop was expected to assist the boys wherever it was possible. If at any time a boy sought information from a journeyman and received a discourteous answer that man was reprimanded.

A system of classifying apprentices which has many good features has been adopted by several Eastern manufacturers. A boy who has a natural talent for mechanical pursuits, but has not the means to serve a four-years' apprenticeship, can fit himself for any one of the different branches of the machinist's trade. For instance, to become a proficient lathe hand he might serve two years; a milling machine hand, two years; planer hand, one and one-half year; bench hand, two years, etc. This system would produce experts in the different branches, but their sphere of usefulness would be limited, and their opportunities would not be as good as those who have served the full apprenticeship.

This system would place many expert classified men on the market who could command higher wages than now prevail, and it would go a great way toward solving the labor problem which now confronts manufacturers all over the country.

A bill was introduced before the legislature of Ohio making it a misdemeanor and a felony, punishable by a fine or imprisonment, for any organization to limit the apprentices in the different trades. This bill was introduced by Mr. Smith of Marion, Ohio, and was bitterly opposed by labor unions, their reason not being apparent to the writer, who was recently called upon to say a few words in defense of it. There should be no barrier in the way of any American boy who desires to learn a trade or profession, but on the contrary, the doors of our factories and business houses should be thrown wide open to give opportunities to develop the brains, muscle and skill of our young men.

* * *

The automobile industry in Germany has increased considerably in the last few years. The import of automobiles to Germany has constantly decreased—27 per cent in 1908 as compared with 1907, and 11 per cent in 1909 as compared with 1908. Meanwhile the exports of automobiles from Germany have shown an increase in the last year of 20 per cent. Thus, the German automobile industry has not only proved itself able to better meet the demands of the home market, but has proved itself able to obtain a considerable portion of the market in other countries.

ELECTRIC BUTT WELDING

By A. E. BUCHENBERG*

In contemplating the practicability of using electric welding machines, the principal questions that should be given serious consideration and be definitely determined by the manufacturer, are as follows: 1. The efficiency and reliability of electric welds. 2. The output of machines in welds per hour. 3. Adaptability of electric welding machines to his work and shop requirements. 4. The cost of operation. 5. The initial cost of machines and such auxiliary apparatus as may be required.

The following article will be devoted to a general discussion of electric butt welding as opposed to brazing and the ordinary forge method of lap welding, with particular reference to shop requirements.

Efficiency and Reliability of Welds

The manufacturer is not so much concerned with the fact that perfect welds can be made electrically, but more vitally interested in the efficiency, uniformity, and cost of the welds, that he may reasonably expect on his product and under his shop conditions. In some classes of work there can be no allowance made for even a very small per cent of breakage from imperfect work, and every weld must be a perfect molecular union over the entire area of the welding surfaces. As an example, we may take the case of the steering mechanism of an automobile, where it is found economical in both machine work and stock to electric weld the threaded steering head to the tubular stem. Under service conditions, this weld may at any instant be called upon to withstand severe longitudinal and torsional stresses which can very nearly reach the ultimate safe strength of the tube's cross-section. The safety of the occupants of the car may depend upon the efficiency of this weld, and before adopting the electric process, the manufacturer must be convinced that the welds can be made under commercial conditions so that each and every one can be absolutely depended upon.

There are many instances where the electric weld, if reliable and practical, will reduce production costs very materially in eliminating expensive machine work and the present unavoidable waste of stock. This is especially true where a great reduction in diameter is called for over a considerable length of a bar or rod. It then becomes convenient to weld a rod of one diameter to another of greater diameter which results in a saving both of stock and the expensive machine work which would otherwise be necessary to remove it. Where a clevis or an eye is required on one or both ends of a rod, drop forgings might be welded to a length of cold-rolled steel. A machine bolt in place of being turned from hexagon stock might be made of two pieces, the head—an automatic screw machine product—welded to round stock of the proper bolt diameter. Where large or complicated drop forgings are required and the initial cost and upkeep of the dies would be high, the part might be made in two or more small drop forgings welded together, and allow the use of simple and comparatively inexpensive dies. From the few examples given, it will be plain that the question of reliability of electric welds may determine to a very great extent the shop production costs, assuming of course that the expense of making the welds is low.

The field of electric welding is being rapidly developed and the process is now applicable to a wide variety of work. In many cases the electric method can be conveniently and economically used where the ordinary forge weld or brazing would be out of the question, either from mechanical considerations or cost. An example is the electric butt welding of tubes, or the welding of tubes to drop forgings, where brazing and forge welds are expensive on account of the preparation of the stock and the time required to do the work.

The quality of any weld, whether made by the blow torch method, the ordinary forge method—usually called a "fire weld"—or electrically, depends entirely upon the efficiency of the molecular union between the welding surfaces. With either the electric or the fire weld, the molecular attraction, or cohesion, is brought about by first heating the stock to a plastic semi-fluid condition and then forcing an intimate sur-

* Address: Toledo Electric Welder Co., Cincinnati, Ohio.

face contact between the two pieces by a succession of blows, as in the ordinary fire weld, or by the application of a heavy mechanical pressure as in the electric process. The "scarf" or lap of the fire weld is a convenience for the application of the blows of the hammer while making the weld and in many cases is a requirement, as when welding surfaces equivalent in area to at least the cross-section of the stock. With the electric process, no scarf or other preparation of the stock is required, the two pieces to be welded bing simply clamped in suitable jaws or dies with their ends abutting, the welding pressure then being applied axially.

The Electric Welding Machine

The electric butt-welding machine which in some of its highly-developed special and automatic forms may be a very complicated piece of mechanical and electrical apparatus, is a structure for first heating stock by means of an electric current and then exerting mechanical pressure to force the welding surfaces together.

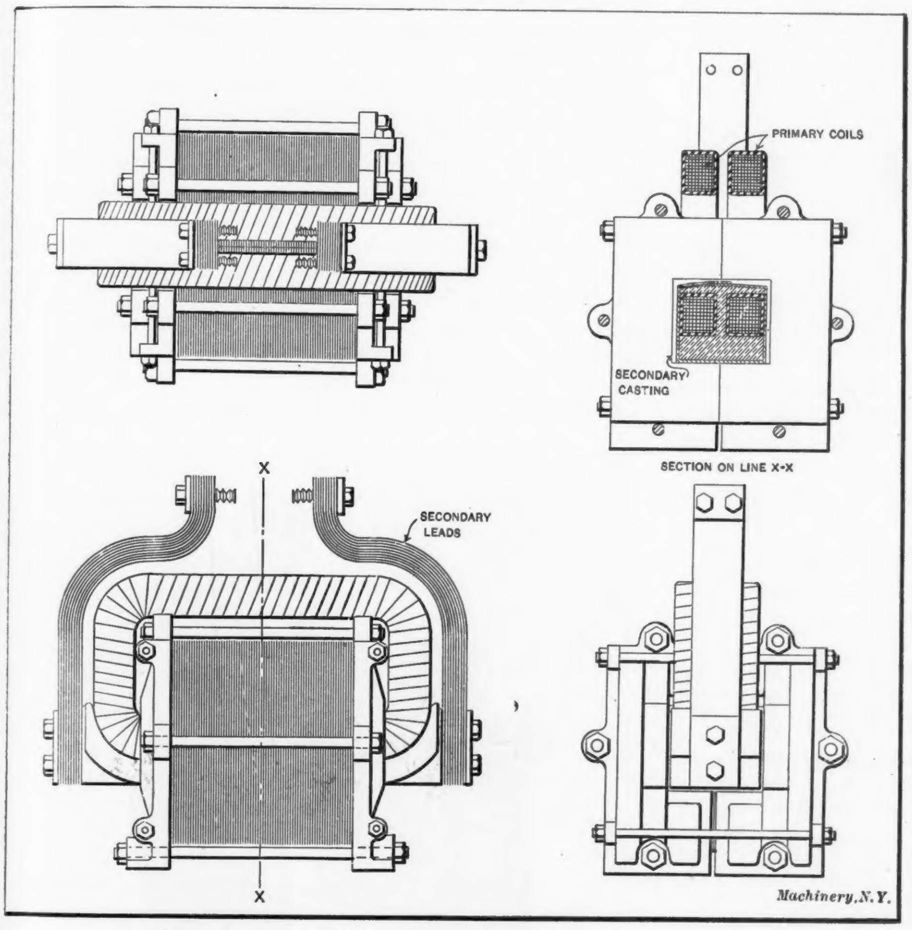


Fig. 1. Elevations and Section of a Typical Transformer for Welding Machines

The component parts of an electric butt-welding machine in its simplest form are as follows:

1. A special type of transformer whose primary coils are connected to an alternating current-supply circuit and whose secondary winding delivers an output of very low voltage but heavy current. The transformer may be operated from any alternating current single-phase circuit of standard voltage and commercial frequency. The usual lighting and power voltages are 110, 220, and 440 volts, while the frequency may be either 25 or 60 cycles. If necessary, the welding machine may be operated from a 133 cycle circuit. Where polyphase alternating current is used, the welding transformer can be connected across one phase of a two- or three-phase circuit. Fig. 1 shows in detail the construction of a typical welding transformer with the connecting leads to the clamping dies attached to the secondary winding. On account of the low voltage required, the secondary winding in this instance takes the form of a solid copper casting extending through the laminated iron core. It will be noted that the secondary leads are each made up of a large number of thin copper strips to afford the necessary flexibility for motion of the clamping dies.

2. Two copper clamping dies and supports in which the stock to be welded is securely held to afford good electrical contact and to prevent shifting and displacement of the work under end pressure. The dies and supports are capable of a limited movement toward and away from each other in suitable guides. In the machine as ordinarily constructed, the left-hand die is stationary but capable of adjustment, while the right-hand support is movable and connected to the compression mechanism. Each die and support is connected to one of the flexible secondary leads of the welding transformer.

3. To afford the heavy mechanical pressure necessary to be exerted at the proper time to force the heated abutting ends of the stock together to form the weld, a number of different arrangements are made use of. The compression mechanism used on a particular machine will depend to a great extent upon the size of the stock to be welded. For the smaller work, a spring or simple toggle lever is used, and for heavier stock, gears operated by a pilot wheel or a hand-operated double-acting hydraulic jack.

Machines for heavy work are seldom made automatic in their operation, since the question of large output per hour is not so important, and it is not always possible to supplant human judgment and skill with mechanical automatic devices.

Fig. 2 shows a simple form of machine for welding straight rods or tubes. The clamping dies *A* are fitted to the work they are to hold, and are mounted on the sliding supports *B* and B_1. The supports are mounted in guides shown at *C*. The clamping dies are operated to grip the stock *D* by means of the clamping levers *E*. The left-hand head *B* is stationary while welds are being made, but it can be adjusted for position by means of the shoulder-screw *F*. The compression toggle lever *G* is connected to the right-hand head B_1 by links as shown at *H*. The welding transformer *J* can be seen through the opening in the side plate of the machine. The foot switch for closing and opening the current through the primary coils of the transformer is shown at *K*.

Operation of an Electric Welding Machine

The several steps in the operation of the machine when making a butt weld are as follows: Two pieces of stock are clamped in the dies with the surfaces to be welded opposed and abutting, the dies being separated from each other a short distance to allow a converging motion for compressing the stock at the proper time. A switch connecting the primary coils of the welding transformer to the supply circuit, and which may be hand- or foot-operated, as convenience may dictate, is closed. The induced secondary current of the transformer now flows through the heavy flexible connecting leads, through the clamping supports and dies into the stock to be welded, and across the abutting surfaces. The junction of the welding stock is the point of highest electrical resistance in the entire transformer secondary circuit, which is made up of the secondary winding, connecting leads, clamping supports and dies, and the small projection of stock over each clamping die. The design of the transformer, secondary leads, clamping supports, dies, etc., makes their combined resistance very small as compared to the contact resistance at the point of weld. In conformity to the laws governing the heating of conductors carrying electric currents, practically all the heating will be confined to this point. In other words, nearly all the electrical energy taken from the supply circuit will be concentrated in this one location in the form of heat.

The secondary voltage of the transformer is so designed that the volume of secondary current forced through the junction of the two pieces of stock will produce a welding temperature at this point in a certain predetermined time. The actual secondary voltage required will depend upon the cross-section of the material to be welded, and whether the stock is iron, steel, brass, copper, or aluminum. The voltage varies between one and six volts.

A voltage regulator of the inductive or "choking" type is usually supplied with each welding machine. This regulator is an auxiliary piece of apparatus connected in circuit with the transformer primary coils, and by means of which the secondary voltage can be readily adjusted through a wide range to afford the best operating conditions on varying kinds and sizes of stock.

At the instant a welding temperature has been reached, the switch is opened and the stock quickly compressed under

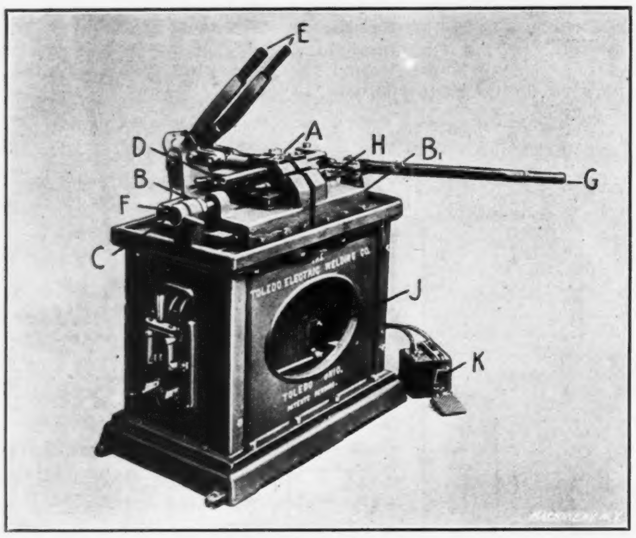


Fig. 2. Simple Form of Machine for Welding Straight Rods or Tubes

heavy pressure to form the weld. A small amount of semi-fluid material is displaced under the pressure and thrown out all around the stock at the point of weld in the form of a fin or burr. When necessary, this surplus metal can be removed by grinding or chipping, or it can be reduced under a power press to the stock dimensions.

Conditions Necessary for Perfect Weld

The primary conditions necessary to make a perfect weld between similar or dissimilar weldable metals are as follows:

1. The welding surfaces must be clean.
2. Each of the two pieces to be united must be at its particular welding temperature. The entire surfaces to be welded must be at this temperature, or in other words, the heat distribution must be uniform.
3. Repeated blows or a heavy continuous pressure must be applied while the welding surfaces are each at the proper heat, in order to form an intimate union between the two pieces of stock.

Below are taken up in detail some of the more important conditions as they exist in the operation of an electric welding machine and in the fire method of lap welding:

Conditions of Welding Surfaces

The primary requisite, that the welding surfaces of the stock must be clean, is fully met in the electric process. Furthermore, the abutting welding surfaces are practically excluded from the air while being heated, and with the short time required to bring up the temperature, little or no oxidization can take place; for this reason, no flux of any description is required even on brass, copper, and aluminum. With the fire process, the welding surfaces are exposed to the action of impurities, particularly sulphur in the coal, or the products of combustion in an oil or gas flame. Under these conditions and the length of time required to heat the stock, the use of a flux as a protective covering against oxidization over the welding surfaces, becomes an absolute necessity.

Heating

In the case of the electric weld, the heating begins in the interior of the stock and travels out toward the surfaces so that every particle of metal at the point of weld is at a uniform temperature. This condition is automatically attained since the flow of current will always be greatest through the path of least resistance. If, on account of varying surface contact resistance, one part of the stock should heat up more rapidly than another, the increased resistance due to the higher temperature would automatically shunt a greater portion of the total current through the cooler part of the stock which is of lower resistance. This action, in combination with heat conduction, would result in an even temperature throughout the stock at the point of weld.

The heating action is concentrated at the junction of the two pieces to be welded, as the time of current flow is so short that the heat travels back but a short distance each side of the weld by conduction. There is no scaling or pitting due to surface oxidization, and the heat discoloration of the material in the case of round stock is seldom visible on each side of the weld for a distance greater than the diameter of the stock. All the heat is concentrated where needed, and there is no waste of energy or fuel in the useless heating of a considerable length of stock on each side of the weld.

The work is always in plain view of the operator who is able to judge to a nicety the instant at which the proper welding temperature for any particular grade of stock is reached. This is an important factor in obtaining perfect welds between materials of widely varying chemical and physical properties, where the proper welding temperature for each material may be at wide variance. Specific instances are the welding of cold-rolled steel rods to drop forgings or the welding of steel stems to brass bolt heads.

With the fire weld the heat is, of course, applied to the surface of the stock and the interior is heated by conduction only. With an intense fire and under conditions of rapid shop production, the outer surface, and especially the thinner edges of irregular sections, may easily be at a higher temperature than the heavier section. This condition may, and unfortunately often does, result in imperfect welds. It is particularly noticeable on lap welds where the stock has been scarfed previous to heating.

With a fire weld using oil, gas, or coal as a fuel, a considerable length of the stock is brought to a high temperature.

Fig. 3. Hand-operated Machine with Output of 250 Welds on Straight Stock with Welding Area Equivalent to 3/4-inch Round Cross-section

There is always more or less scaling and pitting of the stock owing to the length of time required for heating, during which time the surface of the stock is exposed to the oxidizing action of the air. It is a practical impossibility to forge-weld brass and other alloys of copper as the component metals of low fusing point will volatilize before the copper has reached a welding temperature. The stock is buried under a cover of coal or partly hidden in the flames of a gas or oil fire so that it is difficult to judge the temperature without uncovering the stock or removing it from the fire. The result is that the

stock is, in many cases, underheated or overheated, the consequence in either case being an imperfect weld.

When the output of welds per day is large, a very considerable saving of stock is effected by using electric welding machines, since the amount of stock wasted in the upset or fin is much less than the stock required for the overlap and scarf for a fire weld.

There is no danger from an electric shock to the operator of the machine since the primary coils of the transformer are heavily insulated, and the possible voltage to which the operator is subjected is no more than that of the ordinary door bell battery, and so slight that it cannot be felt under any conditions.

Output of Machines

The output, say in welds per hour, of any machine, will be determined by both the electrical and mechanical design. With automatic machines designed for a particular piece of work on light stock, the output is large. As an example, a machine for welding wire barrel hoops will take the wire from the reel, cut it into the proper lengths, and deliver the welded hoops at a rate of approximately 650 per hour. In the case of a hand-operated machine, the output will be determined by the mechanical design of the clamping dies and compression mechanism, the time required to heat the stock, and the facility with which the stock can be inserted in and removed from the machine as determined by its general shape and welding cross-section. Fig. 3 illustrates a hand-operated machine whose output on straight stock with a welding area equivalent to the cross-section of 3/4-inch round stock, will be approximately 250 welds per hour. As a general rule, the larger the stock, the smaller will be the machine output, both on account of the longer time required for heating and the greater length of time required to handle the heavier stock.

Adaptability of Electric Welding Machines

Except in the case of a welder especially designed for one particular piece of work, quite a range in the shape and size of stock can be handled by one machine. A welder equipped with a voltage regulator can be adjusted to weld stock much smaller in sectional area than the rated capacity. As an example, a welder whose maximum capacity is one inch round stock, or an equivalent cross-sectional area in an irregular section, will, with a proper adjustment of the regulator, weld one-quarter inch round stock. However, as a commercial proposition, it is not good practice to weld very small stock on a large machine, as all the working parts are necessarily heavy and cumbersome on light work. For this reason the output would naturally be less than with a smaller, lighter, and more easily operated machine. Usually a change in the size of stock to be welded entails only a few moments time to change the clamping dies to conform to the new stock, and make the proper adjustment of the voltage regulator.

From the standpoint of maximum output, an important consideration in the selection of a welding machine is the facility with which the stock can be gotten into the clamping dies, and the proper arrangement of jigs for accurate alignment of the work. Welders are now designed in standard forms for different general classes of work, and a machine whose welding capacity is ample for a particular piece of work, might be entirely unsuitable for economical production on account of the mechanical design. For instance, a machine designed for welding straight bars or rods would be impractical for taking care of such work as vehicle dash frames; these require a special machine designed so that the dash frame may be conveniently swung into the several welding positions.

Cost of Operation

The operating cost will depend upon the size and material of the stock to be welded, upon the cost of the current, and the number of welds made. No current is used while the stock is being inserted into the clamping dies of the machine, or while being removed after the weld is completed. The amount of electrical energy required will depend upon the kind and shape of the material, and its cross-sectional area. The actual cost of operation is very low as is indicated in the following table, which gives the time and kilowatts per weld required for a number of sizes of iron or steel stock. The tabulated cost per 1000 welds is based upon a unit current cost of one cent per kilowatt hour. The actual cost in any particular instance can be determined by multiplying the cost per 1000 welds as given in the last column of the table by the price of current per kilowatt hour at that locality. The costs given do not include the time of the operator.

TABLE GIVING TIME AND COST OF WELDING VARIOUS SECTIONS IN IRON OR STEEL

Diameter, inches	Area in square inches	Kilowatts, Transformer	Seconds to make Weld	Cost per 1000 Welds, Current one cent per Kilowatt hour
1/4	.05	5	5	$ .07
3/8	.11	7 1/2	6	.13
1/2	.20	8	10	.22
5/8	.31	10	12	.33
3/4	.44	12	15	.50
7/8	.60	15	20	.83
1	.79	18	30	1.50
1 1/8	.99	20	30	1.66
1 1/4	1.23	26	40	2.89
1 1/2	1.77	40	60	6.67
1 3/4	2.41	45	70	8.75
2	3.14	56	80	12.44

Initial Cost of Machines

The first cost of a welding machine will depend to a great extent upon the sectional area of the stock to be handled, and whether the material is iron, steel, brass, aluminum, or copper. The higher the electrical conductivity of the metal, the greater the amount of current required to raise it to a welding temperature in a given time, and the larger the welding transformer required. The cost of the machine will also be governed to some extent by the shape of the section of the stock quite independently of the actual sectional area. Heavier and more expensive clamping dies will be required to weld stock $1/8 \times 6$ inches than would be required for the same area of metal in the form of round stock. In the case just given, special mechanism must be used in connection with the clamping jaws in order to obtain an equal distribution of current along the abutting edges of the stock. Where a great output in the number of welds per hour is demanded, automatic or semi-automatic features become necessary and the cost of the machine is materially increased. Machines built for special work or to meet extraordinary conditions are, of course, much more expensive than standard stock machines. Up to sectional areas equivalent to 3/4-inch round stock, machines are usually operated by means of a simple hand toggle lever. From 3/4-inch to 1-inch round, a handwheel operating through gears may be used. For larger stock it becomes necessary to resort to a special double-acting hydraulic jack.

From the foregoing it will be seen that the first cost will be governed by size and kind of stock, shape of the parts to be welded, and the capacity of the machine in welds per hour.

While a welding machine, especially the smaller sizes, can be connected directly to the circuit supplying light or power to the shop, it is usually better, on account of the line disturbances set up by the intermittent inductive load, to install a separate transformer to supply the welder only. This transformer is usually furnished by the local power and lighting company. Where alternating current is not available, a small alternator driven from the line shafting can be installed to operate the welder.

* * *

Roller chain used for transmitting power has been known to stand up at a speed of 2000 feet per minute, and to transmit 25 horsepower at 1250 feet per minute. Speeds of 1000 feet per minute and under, however, give better satisfaction. Block chain is best adapted to slower speeds, about 700 feet per minute and under. Other conditions being the same, it is preferable to keep the speed high and the chain pull low.

* * *

According to a report by Consul James M. Shepard, practically all Canadian manufacturers of the lighter grades of wood-working machinery and tools have merged into one company, known as the Canadian Machinery Corporation, with headquarters at Galt, Ontario. The complete authorized capitalization of the company is $4,000,000.

MAKING ROLLER BEARINGS

By ETHAN VIALL*

The Elgin Tool Works, Elgin, Illinois, makes all the roller bearings used by a well-known motor-cycle firm, and as the rollers must be extremely accurate, their production on a profitable scale is interesting. Superintendent Hasselquist is, by his practical methods, making money for his firm on a contract that could easily be a loser. In order that the reader may have a clear idea from the beginning as to the kind of bearings referred to, a side and end view as well as a set in a cage are given in Fig. 1.

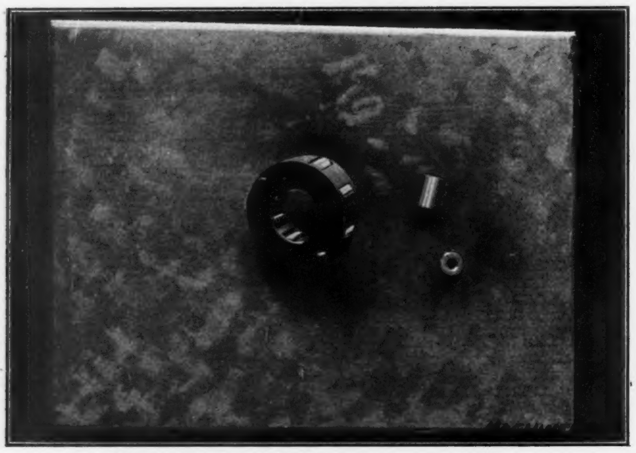


Fig. 1. View showing Roller Bearings and Cage

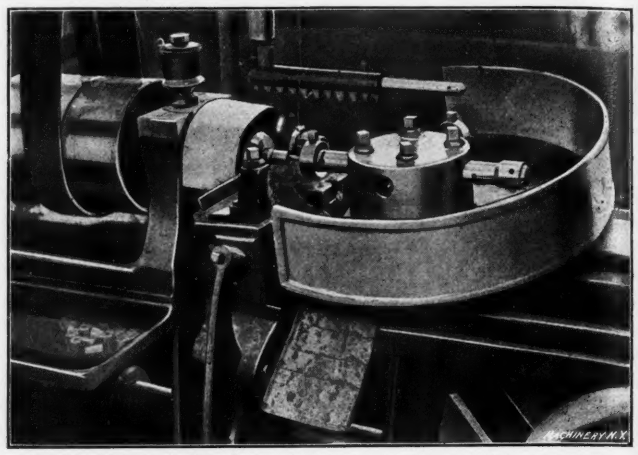


Fig. 2. Automatic Machine in which Bearings are drilled and cut off

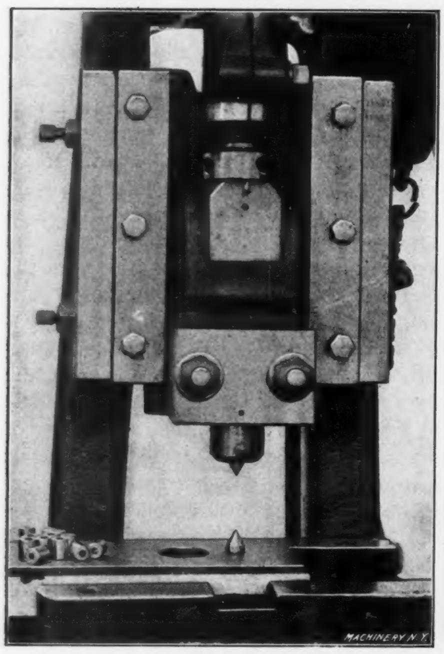


Fig. 3. Punch Press arranged for "Countersinking" the Bearings

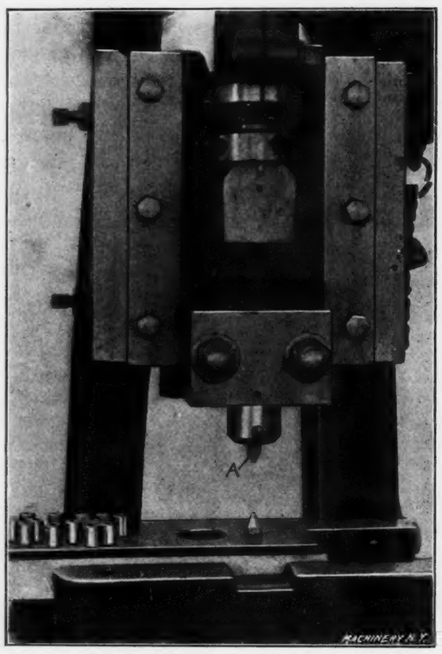


Fig. 4. Making a Three-cornered Center used for Driving, in the Grinding Operations

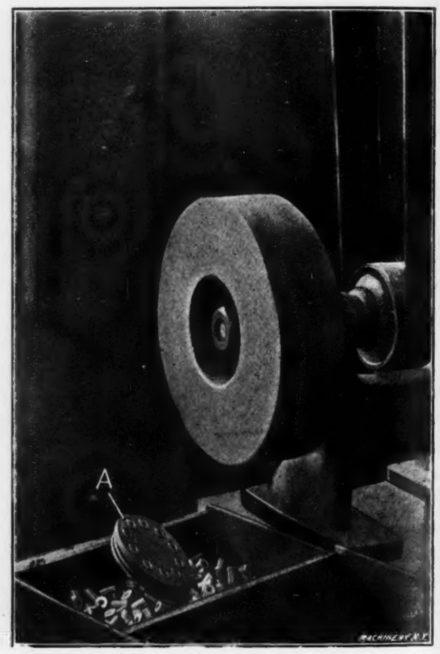


Fig. 5. Jig in which Bearings are held while Burrs are being removed by Grinding

Fig. 6. Grinding off the Burrs which have been thrown up in the Punch-press Operations

Fig. 7. Inspecting the Bearings for Length

The rollers are made from long round bars of carbon steel, and the first shop operation consists in running these bars through an automatic machine, as shown in Fig. 2, which drills a hole through the center and cuts them to length, the operator in charge inspecting the pieces and keeping the sizes within certain limits. Next the rough rollers go to a punch press where the drilled holes are "countersunk" by being squeezed between centers as shown in Fig. 3. In the next operation the spherical center in the ram of the press, is replaced by a three-cornered center, *A*, shown in Fig. 4, which is used to mark one of the countersunk ends with three nicks or notches for the purpose of driving, in some of the following operations. The rollers are now placed ten at a time in a grinding cage or jig *A*, shown in Fig. 5, and the ends ground by holding them against an emery wheel as shown in Fig. 6. This grinding removes the

* Associate Editor of MACHINERY.

burrs raised by the punch-press operations and leaves a smooth finish on the ends. A rigid inspection for length comes next as shown in Fig. 7. Snap gages are used for this operation, the limits of which are 0.495 and 0.4975 inch, after which the bearings are heated in the furnace *A*, Fig. 8. From this they are quenched by being raked out of the front, where they drop down a chute into a barrel of water. They are then drawn to 490 degrees F. in the oil bath *B*. The pieces are now dipped

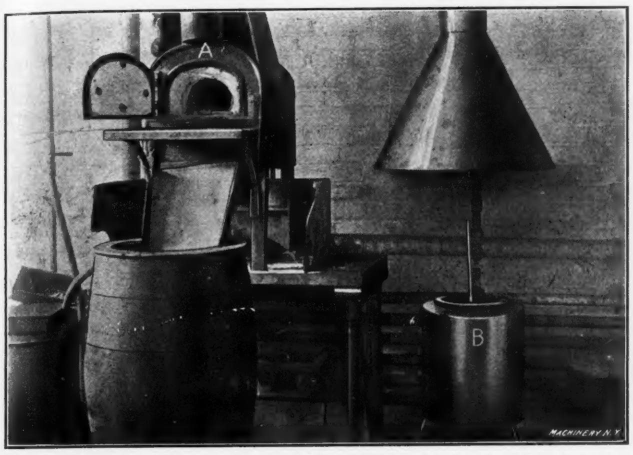


Fig. 8. Furnace and Oil Bath in which Bearings are hardened and drawn

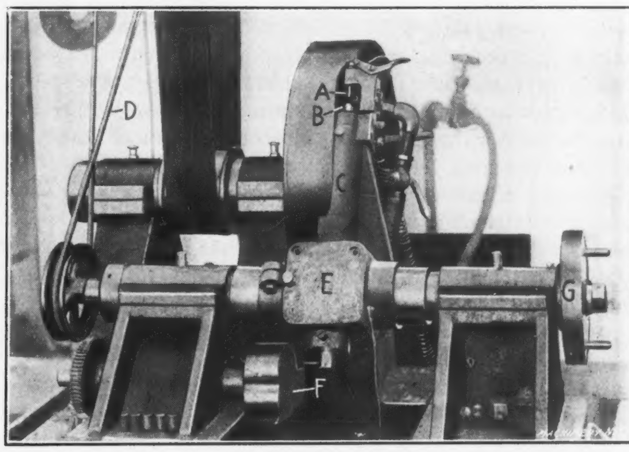


Fig. 9. Automatic Grinder in which Bearings are rough-ground

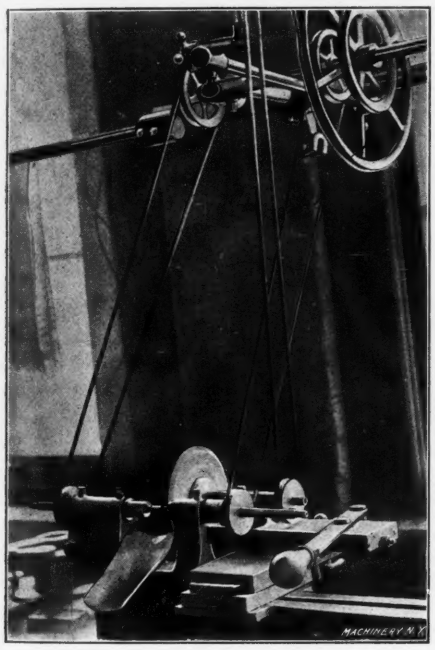


Fig. 10. Grinder in which Bearings are finish-ground

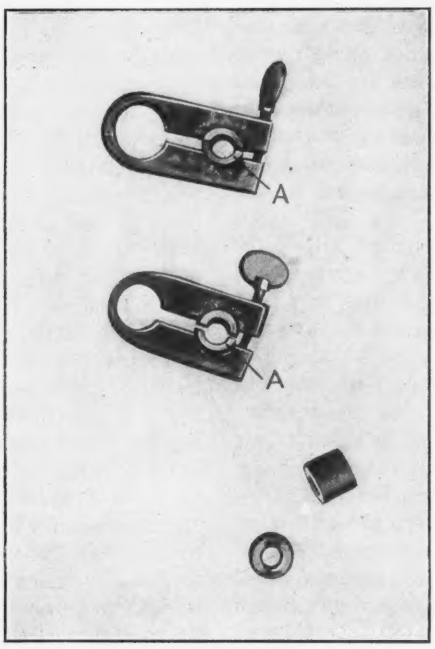


Fig. 11. Laps and Holders used in Finishing Bearings to Size

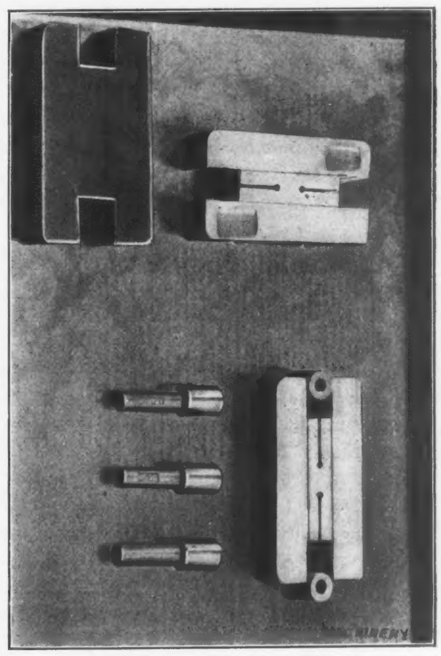


Fig. 12. Snap Gages and Master Plugs for Testing them

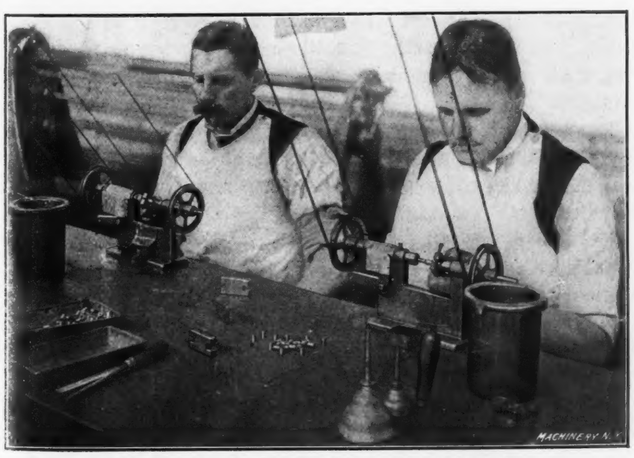


Fig. 13. Lapping the Bearings to the Finish Size

in potash to remove the oil, and the outside is next rough-ground on the automatic grinder shown in Fig. 9. This grinder has been made especially for the work it performs. The roller to be ground is placed between the centers *A* and *B*. *A* is a dead center, while *B* is a live one and is ground three-cornered so as to fit into the three nicks previously made in the roller. The roller is rotated as the arm *C* feeds back and forth across the cutting surface of the large cup-wheel. The live center is driven by the belt *D* through a pair of bevel gears in the box *E*, while the arm is given a reciprocating motion by means of cam *F*. A very fine feeding adjustment is obtained through the use of the graduated wheel *G*.

From this automatic machine the rollers are taken to a grinder shown in Fig. 10 where they are finish ground to within 0.0003 inch of the final size; after which they are placed in the machines shown in Fig. 13, and lapped to size, using the laps shown in Fig. 11. The frames of these laps are made of steel into which are soldered copper bushings *A*, *A*, which are made of copper rod drilled out and cut off in a screw machine, the bushings being first soldered into the frame and then split with a hack saw.

After lapping, the rollers are given a final inspection for length, size and parallelism, by using the gages shown in Fig. 12, the limit on the outside diameter being 0.0003 inch. The plugs shown in this engraving are master plugs for the testing of the snap gages.

Thanks are due to both Mr. Hasselquist and Mr. Graham of the Elgin Tool Works, for the photographs and description of these shop operations.

* * *

Fred Bangerter is the inventor of a machine gun which fires 16,000 bullets a minute without the explosion of powder. A demonstration of the gun was made recently in the factory of the Auto Machine Gun Co., 79 Broad St., Stapleton, Staten Island, which showed the possibility of the invention. It is claimed that the cost of firing is only about one-thousandth part of that of firing machine guns loaded with cartridges. The principle of the new gun has not been made public.

OUT-OF-DATE DIE-MAKING METHODS

By JETHART

In the June issue of MACHINERY F. E. Shailor has an article entitled "Out-of-Date Die-Making Methods," which is open to some comment.

In the first place, his very first paragraph is too sweeping a condemnation of existing practice, as there are many cases in which punches made in the way he condemns so strongly are by far the best. I do not deny that for some classes of work, and especially for large punches, the method he advocates is in some ways all right, but if followed generally, it would result in a large waste of material for punches, because, in order to get the necessary size of shank and flange, the stock out of which the punch should be made would be much larger than necessary. For his example Mr. Shailor takes altogether extreme cases, which, perhaps, show his methods of die-making to be good in some points, but lacking in the general run of small and medium sized dies. I do not think that his methods are any improvement, and in fact, in some points, I cannot see how he makes an accurate punch and die at all.

Again, he makes no mention of whether the stripper is a tight or a loose fit on the punch, which is an important factor in die making, or what thickness of stock his die is to blank and pierce, which is another important factor. If he is going to work thick stock, the construction of the punch shown in Fig. 4 of his article is justified, although the method of holding it in the punch plate is not. Two screws will not stand much when stripping thick stock from a punch of such a shape, which gives a large area of stripping surface; and also, the one dowel in the shank is not of much value if the punch takes a "half" or "quarter cut" in thick stock. Two extra dowels as far apart as possible are desirable, also more screws and the shank riveted over.

The next objection he has is the difficulty of fitting the punch tightly in the punch plate. He makes a very long and tiresome job of it, filing absolutely straight and to 0.0001 inch. He also objects to the manner in which the piercing punch holes have to be transferred from the die to the punch plate. He apparently raises all the obstacles he can in front of any man who would dare to make a die in this manner. Surely in any modern shop it is easy enough to grind a pair of parallels to the same thickness. I may say that after years of experience I have never had any trouble from this cause, providing reasonable means were taken to keep the drill press table square with the spindle.

And now, let me ask Mr. Shailor a few questions about how he makes his punch and die. He says that the punch plate, stripper and die would be doweled together, laid out, indicated, and the holes for the piercing punches drilled and bored. Now which plate does he put uppermost, and on which does he make his layout? From the fact that he says the holes were indicated, drilled and bored, I understand this operation was performed on the lathe faceplate. Now in the die shown in Fig. 4 of his article, the holes are not all of the same size as those in the stripper and punch plate. How does he bore them all at the same time, and which plate does he work from? According to his ideal punch, the holes would be a different size in all of the three plates. If he makes his layout on the face of the die, as is the usual way, and works from it, then it has the smallest holes of the three and they are tapered back for clearance, the holes in the other two plates being much larger. I imagine that it would hardly be practical to make the layout on either of the other two plates, so the way he apparently does is to drill and bore right through, the size of the hole in the die and remount the stripper and punch plates on the faceplate, indicate them again and bore out to size. This means a lot of work and also chances for error. But the part that puzzles me most is—all this is done with the die still to harden. If Mr. Shailor can harden a die of any size without making any alteration or shrinkage, I wish he would let us know his method. Of course, if he uses bushings for his piercing dies, he can transfer the holes again from the stripper, which would be another source of error, but even then, what about his dowels? The whole alignment of the die, stripper and punches depends on the dowels. If the die does not shrink or warp one way or another in hardening, it is something out of the ordinary. Mr. Shailor might enlighten us on this point.

Next Mr. Shailor surely has a curious way of shearing his blanking punch into the die. He says he uses the piercing punches as guides while shearing in the blanking punch. What about the clearance between the piercing holes in the die and the piercing punches? If the stock to be worked is any thickness at all, such as would necessitate such a strong construction of blanking punch, then the clearance between the punches and the die would be no small amount, so that the punches would not be much of a guide while shearing; also the holes in the die are tapered and are open to the same objection for shearing, as for spotting through with a drill.

Mr. Shailor next calls attention to the rigidity, etc., of his style of punch, and the absence of any possibility of its springing on a "half cut." Now if I may be allowed to say so, it has been my experience that, in ninety-nine cases out of one hundred, it is not the punch which springs when taking a "half cut." A punch of such a size and shape as the one shown in Figs. 5 and 6 in the accompanying illustrations, when projecting only 1 3/4 inch from the punch plate, requires something solid to spring it. I have always found that the cause of the so-called "springing" was nothing but slackness in the slide of the press, which with a slack fitting stripper is as liable to bring disaster with a stiff punch as with a slender one. The only remedy, outside of the sub-press die construction, is the tight fitting stripper, which always keeps the punch in perfect alignment with the die, no matter if there is a little slack in the slide of the press. To fit a tight-fitting stripper to a punch made as shown by Mr. Shailor, would necessitate either a very thin stripper, which would be of no use, or else a considerably longer punch.

In the same paragraph Mr. Shailor also calls attention to the reduced chances of the punch springing out of shape when being hardened, when made in his way. Mr. Shailor dwells too much on the chances of the punch distorting and never mentions the chances of the die going any, after being doweled and fitted to the stripper and punch plate while soft.

Fig 6 of Mr. Shailor's article shows a construction which is only permissible on large punches. He draws an absurd example when he asks one to imagine a punch 1 inch long by ½ inch wide fitted in this manner. I do not think that Mr. Shailor ever saw very many punches of that size fastened in that way. It would also surely be very foolish for anyone to plane out the slots in the punch plate before hardening the punch. Why not harden the punch first? Then there would be no trouble with the slots fitting the punch, and, anyway, if the punch distorted that much, it surely would not be a good fit in the die. Besides on a punch 1 inch by ½ inch the distortion would not be as much on the cross-section of the punch as on the length, and it has as much chance to bend lengthwise when made with a flange and shank as when made straight.

The sectional die referred to I can endorse, as I have found it to be all right, and, in fact, it is the only practical way in which to make a large die containing any number of piercing punches.

The paragraph in Mr. Shailor's article following the editor's reference to Fig. 10 is surely altogether uncalled for. The first statement is open to question, as I have shown, on account of the die warping and shrinking in hardening, which makes the bored holes in the punch plate and stripper of no value. Mr. Shailor tells how some diemakers throw things about and with a twist drill "soak" the holes into the plate from the die, and after the punches are in place knock them this way and that with a hammer. I do not know how you "soak" a hole into a plate, but I think that Mr. Shailor is stretching a point or two in this description. Because he may possibly have seen one or two men do a job in this manner, he should not suggest that it is common practice among toolmakers. At least, in my experience of many years both in the United States and in Great Britain, I never came across any such men. As to his remarks regarding peening,

I will say that, in case it was necessary to peen over a punch, if the stripper were tight fitting, the peened metal would not flow back again, as the punch is kept true by the stripper. It is only when the stripper is slack for the punch that there is any danger of the punch returning to its "old position."

Regarding Fig. 8 of Mr. Shailor's article and his remarks on piercing punches, his ideal punch shown at *C* seems to me to call for an enormous waste of stock; also the toolmaker must have plenty of time at his disposal to bore the plate and turn so many sizes on the punch. It would have to be enormously thick stock to be pierced to tempt me to make a punch in such a way. Figs. 5 and 6 in the accompanying illustrations show the style I always use. This is made from a standard size of drill rod in the draw-in chuck on the lathe.

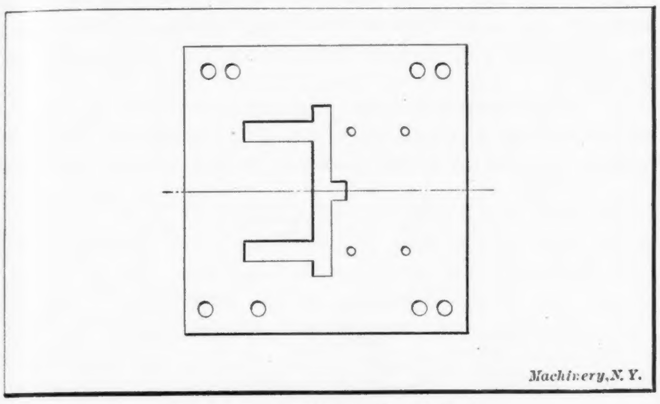


Fig. 1. Plan of Die showing Layout

The end is turned down to size as shown for a length of about ¼ inch. This allows the body size of the punch to be well entered into the thick stripper in which it is a tight fit, before the piercing commences, so that the punch is properly supported when at work. The body of the punch is a driving fit in the punch plate and is riveted over at the back and filed flush. When made in such a way you can get as stiff a punch as you may want for the minimum of labor; and when well supported in the stripper, a much smaller punch can be used. For very heavy work I usually insert a hardened steel disk in the punch holder above each piercing punch. This prevents any possibility of the end of the punch compressing the metal, and so working a depression in it, allowing the punch to slide up and down at each stroke.

In commenting on boring the holes for the guide posts in Fig. 9 of his article, Mr. Shailor says: "It is a long, expensive and difficult job to bore four one-inch holes in the

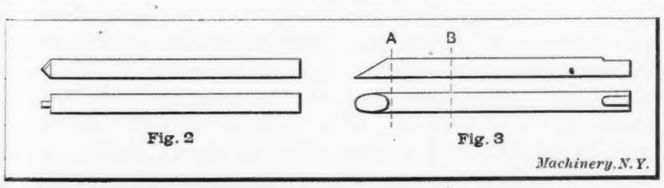


Fig. 2. Spotting or Centering Drill Fig. 3. Reamer

top plate and four one-inch holes in the bottom plate and have the four pins line up with and travel freely in the holes." I would suggest that he use his own method of making the ordinary piercing and blanking die, namely, dowel the two plates together and bore all four holes right through, putting a hardened and ground plug in each hole as bored. This would insure correct alignment. However, I believe the babbitt would be better, and it would certainly be easier done.

As a final comment on Mr. Shailor's article I might say that there are two ways of doing every job, and because every one does not make their dies as he does, he should not say they are not out of their infancy yet. I venture to say that there is much fine die work done which Mr. Shailor never sees or knows anything about, and which is done in the way he disparages so much. In his descriptions of die work all his work is laid out, indicated, drilled and bored, while the other fellows indulge in "soaking" holes with a twist drill, knocking punches with a hammer and peening metal with a blunt chisel. Does the diemaker who makes his dies in any other way than the one described by Mr. Shailor never use an indicator or bore out a hole? He might show a little more fair spirit.

Now let me state how I would make the same punch and die, making the punch straight all the way up, and compare the two methods. The die would be filed out to fit a templet and the holes drilled and reamed tapered for the piercing dies or counterbored for the bushings, depending on the accuracy required and the size of the die. Fig. 1 shows the layout of the die and shows the positions of the dowel and screw holes. The dowel holes are drilled right through and reamed, and the screw holes are also drilled right through, equal to the body size of the screw, as I would fasten such a die in a good stiff bolster. The die is now ready to harden; but I always plug all dowel holes with fire clay before hardening, as this leaves the walls of the holes soft, and they can be reamed to size after the die is hardened. If the dowel holes are countersunk slightly at each end, it serves to hold the fire-clay plugs in place and also does away with the hardened edge of the hole, which makes reaming impossible. After hardening and tempering, the die is ground top and bottom, stoned or lapped out if required, and the dowel holes reamed. The punch block is then coppered or blued on the face and clamped to the die and the outline of the die scribed through to it. The punch block is then machined to the lines on the milling machine, leaving a few thousandths for filing, making the punch as shown in Fig. 3 of Mr. Shailor's article. After machining the edge all around, the face of the punch is beveled slightly with the file, just enough so that the punch will enter the die evenly all around. It is then placed under a hand press and the impression of the die taken on the beveled edge of the punch face. The punch is then filed away to these marks and the operation repeated, shearing the punch through the die, care being taken to always keep the punch

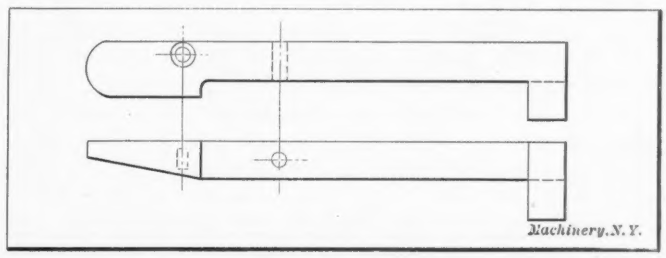


Fig. 4. Finger Stop

square in the die and not to file too deep, so that the punch, when sheared through the die, is parallel all the way up. After relieving the punch the required amount (depending on the thickness of the stock to be worked), the holes are drilled in it for the pilots, these being drilled clear through, so that the pilots can be knocked out when the punch requires grinding. The punch is now ready for hardening, which is done as follows:

The face of the punch for about ¾ inch up is held in molten lead until it is an even red color all over. It is then quenched. This hardens the face of the punch for about ¾ inch up and leaves the back soft. This method has very little tendency to warp the punch, the large part of it, which is cold, or comparatively so, counteracting it. My experience has been that if properly done, the punch comes out straight and parallel and not warped at all. The temper is drawn from the back in the usual way. After hardening and tempering, the punch is ground on the face.

The stripper plate is now taken in hand. This is made thick, usually from mild steel ½ inch to ⅝ inch thick and is the same length and width as the die. It is clamped to the face of the die, squaring it up with the sides and ends, and the outline of the die scribed through on it. Then it is drilled, chipped or machined, and filed square all the way through, almost to the lines. The edges of the hole on the top face of the plate are now beveled slightly to allow the punch to enter evenly all around. The punch is put in place under the hand press and the press brought down, marking the outline of the punch face on the stripper plate. The hole is now filed out to this mark and the punch sheared into it, care being taken to

keep the punch square with the plate. If too much stock has been left in the hole, the punch will not shear right through, but it can be forced back again, the surplus stock in the hole filed out and the punch forced in again, this operation being repeated until the punch goes right through. The hole is then polished out until the punch can be pushed through by hand without shake, being a tight fit all the way up. The next operation is the drilling of the holes in the stripper plate for the piercing punches. This is done as follows:

The punch is pushed through the stripper plate until it projects about ¼ inch. It is then entered in the die and the die and stripper plate clamped firmly together, with two ⅛ inch parallel strips between them. When clamped the punch should be easily removable, so that there is no fear of the punch binding hard on one side of the die. The holes are then spotted through with a spotting drill, which is shown in Fig. 2. This drill is easily made from drill rod, being turned to the size of the holes in the die. The ⅛ inch between the die and the stripper plate allows the drill to project far enough through the die before drilling to have a good bearing on the edge of the hole in the die, as, the hole being tapered, it is only the edge which guides the drill. If the drill is fed down gently and is a good fit for the hole in the die, it will make a true center every time. After spotting, the die is removed and the stripper plate drilled and reamed to the body size of the piercing punches. The punches are then made from straight drill rod, being turned down on the end to fit the die, as shown in Figs. 5 and 6, and made a tight sliding fit in the holes in the stripper plate. They are then hardened and tempered. The next step is transferring the dowel and screw holes from the die to the stripper plate. The punch is inserted through the stripper into the die and the two clamped together as before, but without the parallel strips between them. The stripper plate is then adjusted on the die until each piercing punch can be freely inserted through the stripper into the die. When all the punches, blanking punch as well, can be freely inserted and removed by hand, the die and stripper plate are in the correct relation to each other, and the dowel holes can be spotted, drilled and reamed, and the dowels driven into place. The screw holes are then drilled and counterbored.

The guide plates are then clamped in the correct position on the die and are drilled and reamed for the dowels, and drilled for the screws. These guide plates are usually made just thick enough to let the stock slide easily between the die and the stripper plate. The die is then fitted to a cast-iron or malleable bolster, as shown in Figs. 5 and 6, the screw and dowel holes being transferred through it and the holes drilled for the piercing and blanking holes in the die. The punch is now clamped to the back of the punch plate and its outline scribed thereon, and the same procedure followed as in the case of the stripper plate, only the hole is not polished but is left tight. The punch is forced through the plate, leaving just enough projecting to rivet over, the edge of the hole in the plate having been beveled to allow riveting, before the final shearing. A punch fitted in this manner needs no peening to tighten it, and after riveting over it will be found rigid enough for any service. The riveted end of the punch is filed or ground flush with the punch plate, leaving a flat surface for the punch holder to rest upon.

The punch is again inserted in the stripper plate, the punch plate and the stripper plate clamped together and the holes for the piercing punches spotted through the stripper plate into the punch plate, then drilled and reamed to size and countersunk slightly on the back for riveting. The piercing punches are then driven in and riveted over and filed off flush on the back. The punch holder is then screwed and doweled to the punch plate, the holes having been transferred previously.

If all the operations are properly performed, it will be found that the punches enter the stripper tightly, requiring tapping through with the hand, and they will each enter the die in perfect alignment. The pilot pins are then fitted to the punch.

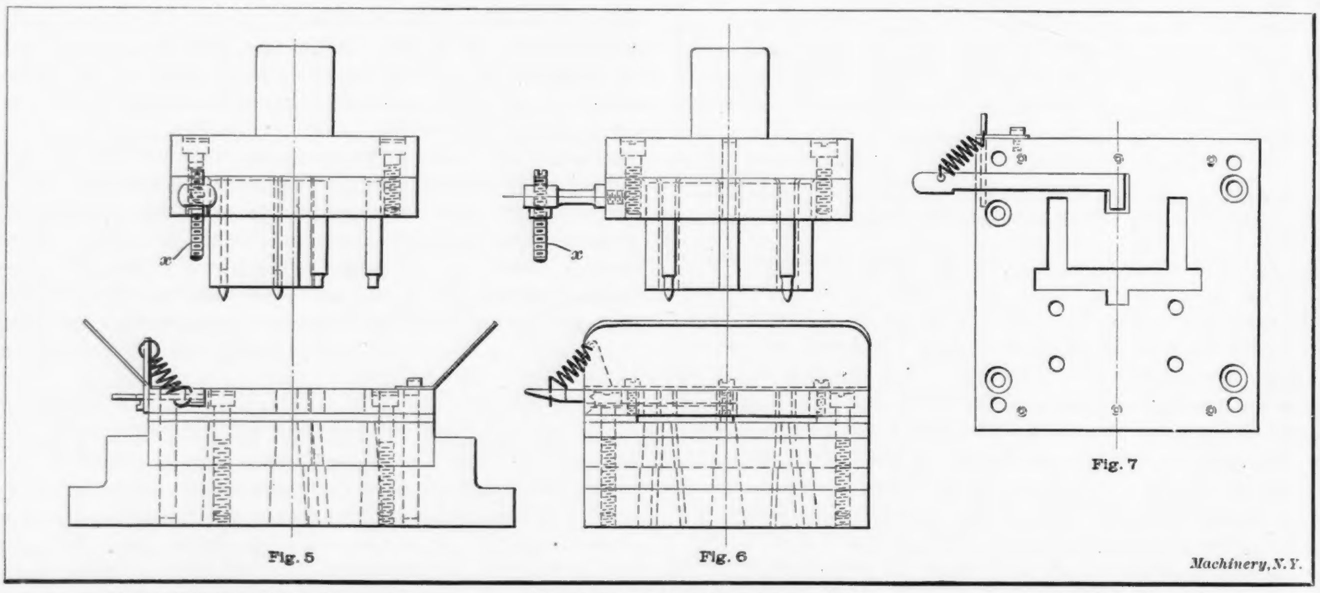


Fig. 5. Side Elevation of Assembled Punch and Die

Fig. 6. Front Elevation of Assembled Punch and Die

Fig. 7. Plan of Stripper Plate showing Stop

The finger stop shown fitted to the die in Figs. 5, 6 and 7, and shown in enlarged detail in Fig. 4, has been found to give satisfaction on blanking dies and on combined blanking and piercing dies, where pilot pins are available on the blanking punch. It is very rapid, as the feeding is continuous, the press never requiring to be stopped until the end of the strip is reached. This stop, however, works best on small work, as on large work the stock cannot be pushed or pulled through the die quick enough to allow of the press running continuously. The stop is fitted rather slack in the slot in the stripper plate, which slot is not cut clear through the plate on account of weakening it. The face of the stop is fitted so that when the stock is pushed against it the pilot pins on the blanking punch will draw the stock back two or three thousandths inch before blanking, thus insuring that the stop is free and does not get jammed. The screw at *x*, Figs. 5 and 6, which is fastened to the punch plate as shown, is adjusted up or down until the correct position is found and is then locked by the lock-nut shown. The spring shown attached to the stripper plate and to the stop, keeps the stop down on the face of the die when the punch is at the top of its stroke. The action of the stop is as follows:

The stock is pushed up against the stop and the press tripped, and as the punch comes down the screw *x*, Figs. 5 and 6, strikes the stop and by depressing that end raises the other end until it goes up into the stripper plate. The pilot pins are made of such a length that they just enter the holes in the stock before the stop clears it. On the punch rising,

there being so little space between the die and the stripper, the stock is stripped before the stop descends and there being a constant push or pull on the stock, the stop lands on top of the scrap stock between the blanks, and drops into the next space, the stock coming up against the stop as before. On small work this is the fastest working stop I have yet seen.

The guards shown fitted to the die are made of sheet steel and prevent the operator from slipping his hands under the punch when at work, as the stock is all fed through under these guards. The guards are fastened to the stripper plate with two or three screws each. I should also state that the punches in a die such as I have described should never leave the stripper, only travelling up far enough to strip the stock, an adapter being fitted to the press to make the stroke the required length. If the punches leave the stripper in operation, and there is any slack in the slide of the press, the punches are liable to shear the stripper, thus destroying the effect of the tight-fitting stripper. Fig. 3 shows the type of reamer I use for reaming out dowel holes and holes in the stripper and punch plates for punches. It is made from drill rod of the size required, and is turned parallel to the dotted line *A*, then it is tapered back 0.002 inch or so smaller to line *B*, about 1 inch, then turned parallel to the end, the tapering back allowing for clearance. The end is then filed off as shown and the other end either squared or flattened for a tap wrench. This reamer works satisfactorily, is very cheaply made, and makes a very smooth hole. I usually make these reamers about 0.0005 inch or 0.001 inch under the size of the drill rod used for dowels and punches. By doing so, the slight amount the reamed hole is larger than the reamer and the contraction of the dowels and punches in hardening and polishing to temper, makes the fit just right—a nice driving fit being the result, and the dowels and punches not requiring filing. I ease the body of the punches with the file in the bench lathe, on the part that enters the stripper, just enough to let them slide in the holes in the stripper plate. By hardening and tempering all dowels to a dark straw, they have no tendency to seize in the holes in the soft stripper. These reamers will remove only a few thousandths from a hole, so I use a drill to bring the holes to the required size. By using only standard sizes of drill rod for all dowels and punches, the number of these reamers and drills required is greatly lessened.

* * *

THE ELECTRIFICATION OF THE LAPLAND RAILWAY

The Swedish government has decided upon the electrification of the Kiruna ore-field branch of the Lapland railway, which railway belongs to the Swedish state. No railway electrification has hitherto been undertaken where even approximately the same demands have been made upon the capacity of the locomotives, as will here be the case, namely, the hauling of freight trains of 2200 tons gross weight, inclusive of the locomotive, at an average speed of 23 miles per hour, over a road having long and heavy grades. For this reason some data relating to this undertaking may be of interest.

The portion of the line to be electrified is about 80 miles long and is used chiefly for the carrying of iron ore, only two or three passenger trains passing over the road in each direction daily. The electric power is obtained from water falls in the Great Lulue River, to which the state holds undisputed rights. The maximum power required for the railway traffic at the outset has been put at 23,600 turbine horsepower, and it is proposed to install at first two 12,500 horsepower turbine units in addition to a reserve turbine. The electric equipment, including thirteen ore train locomotives, two express locomotives, transformer stations, feeding lines and overhead conductor lines, is to be furnished by the General Swedish Electric Co. and the Siemens-Schuckert Co.

These companies have bound themselves to very severe conditions as regards the carrying out of the contract. They guarantee that two of the ore locomotives as furnished, one in front and the other behind the train, shall transfer two iron ore trains of 2040 tons and bring back two empty trains of 500 tons weight per day, besides doing the requisite shunting at way stations. The locomotives shall be able to perform this work continually for six days, and each locomotive shall accomplish 56,250 locomotive-miles in the year. The express locomotives must be able to take trains of 220 tons net weight over the line three times daily back and forth. These locomotives must be able to run an aggregate of 62,500 locomotive-miles per year. The consumption of energy is guaranteed by the firms not to exceed, for express trains, 45 watt-hours per ton-mile; for ordinary passenger trains, 45 watt-hours per ton-mile; for iron ore trains, 32.5 watt-hours per ton-mile; and for empty car trains, 34.5 watt-hours per ton-mile. These figures are exclusive of heating and lighting and are to be measured on the locomotives on the high-voltage side of the transformers, under ordinary weather conditions and with rails and rolling stock in good condition. For the handling of the ore train only three men are assumed to be necessary.

When the entire electric installations have been duly tried and taken over by the state railways, the working, maintenance and inspection of the electric installations will pass to the state, but the firms guarantee the maintenance cost for the installation for two years from the day the installation has been definitely taken over by the government. The government, however, has the right to demand the extension of the guarantee for another twenty-three years upon paying to the firms an additional five per cent of the purchase price for the third year, and one per cent for each following year, until an aggregate excess price of ten per cent has been paid for this guarantee. Within a period of three years after the installations have been accepted by the government, however, the firms are bound, should the state railways demand it, to remove without any compensation whatever, the installations delivered, including the electric locomotives, and pay back the payment received up to the time of removal, under any of the following contingencies: *a*. If the working should prove unsafe. *b*. If the machinery should prove unsatisfactory in its working. *c*. If the maintenance cost be excessive. *d*. If the current consumption be excessive.

The firms, on their side, have the right to work the installation, if the results obtained by the government prove unsatisfactory, at the maintenance and working rates agreed upon for the installation, the government in that case paying over to them the stipulated amount yearly. The total amount of the contract of the two firms is approximately $1,420,000.

A few particulars of the line to be electrified may be of interest. The whole length is 81 miles, of which only 22 miles are level, 31 miles having a rising, and 28 miles a falling grade. Over 21 miles have gradients of one in one hundred, and practically half of the whole length of the line is curved, the smallest curve radius being about 1000 feet. The total cost of the installation, including power station, is estimated at $4,800,000.

* * *

GRINDING WHEEL AND WORK SPEEDS

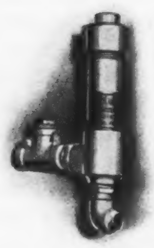
A slow grinding wheel peripheral speed is 3500 feet per minute; medium, 5000 to 6000 feet, and fast, 7000 feet. Certain experts grinding small special work, run their wheels as high as 8000 feet, but that is an exceptional, not to say dangerous, speed. A low work speed, according to the views of one grinding authority, is 20 feet per minute; medium, 50 to 60 feet, and fast, 120 to 125 feet.

* * *

Naval authorities of the leading powers are considerably agitated by the report that the naval engineers of Great Britain are about to develop a dreadnought type of battleship driven by internal combustion engines. The advantage of this new type will be absence of smokestacks and smoke, greater economy of fuel, saving of weight and greater speed. If the internal combustion engine proves successful for naval vessels, all the great navies of the world will be made obsolete and the millions of dollars that have been expended will be wasted. What better proof of the folly of the big navy policy could be had than this possibility of rendering the enormous expenditures of the past twenty years useless?

COOLING GAS ENGINES

By GEORGE J. MURDOCK*



The birthplace of the gas engine was the machine shop, and there its development has been strenuously continued, until it has reached the point where it has driven practically all small power competitors from the field, with the exception of the electric motor. Everything that tends to cheapen the cost of operation and contributes to the design of a compact engine widens its scope of usefulness.

Wherever combustion engines are found the problem of keeping them cool is an ever-present difficulty, and one which is commonly overcome on lines which are almost as antiquated as the fundamental principles on which the engine works. In cities the cost of water for this purpose is high, and in isolated localities it is seldom that running water can be conveniently obtained, thus necessitating pumping from wells or cisterns at considerable expense of power, to keep the temperature of the engine cylinder within permissible bounds. Where city water is available it can be piped to run by the pressure of the mains through the water jacket, but it is always metered, and costs in some cases as much as $10.00 per horsepower annually. A 10-horsepower gas engine is therefore somewhat expensive to run, aside from the cost of fuel.

Investigations conducted by the writer disclosed the fact that out of 500 engines running in the vicinity of New York City with a total capacity of 17,250 horsepower, for more than 15,000 horsepower city water was used for cooling purposes, at an average annual cost of $7.00 per horsepower, thus involving an expenditure of more than $100,000 each year,

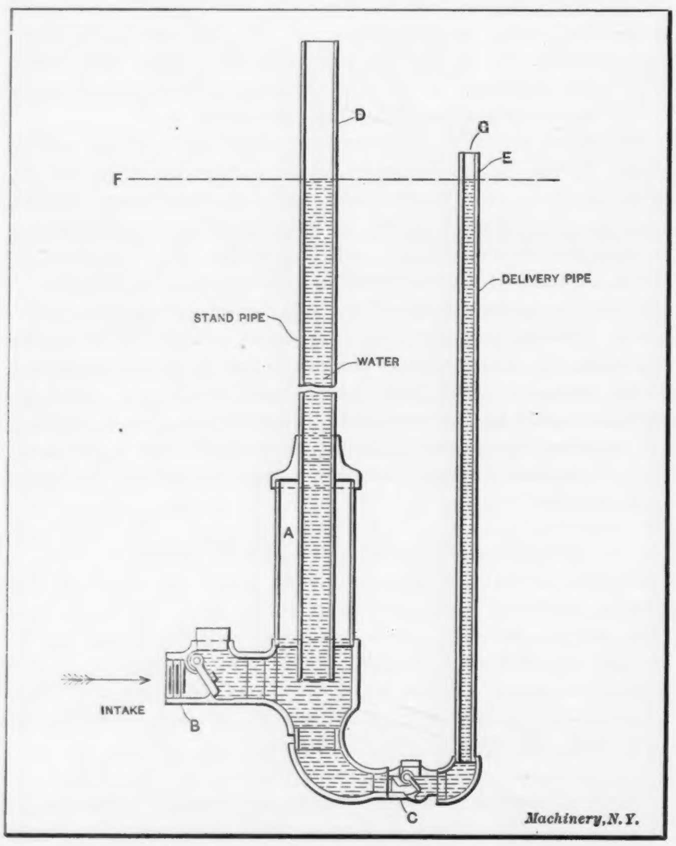


Fig. 1. Diagram showing the Pump, Stand-pipe, Exhaust Pipe and Delivery Pipe assembled

which is a total economic waste, in view of our present knowledge of a better method for accomplishing the same result at practically no expense. On this basis it is estimated that in larger cities of this country not less than $3,000,000 worth of water runs into the sewers every year after having accomplished the purpose for which it is used. This huge waste is not the cost of producing power, but one of the consequences of its production. Space is very valuable in cities, and also of some value everywhere an engine can be used, so the large water tank necessary for use with the thermo-syphon cooling system may easily occupy room, the rental of which, and value for other purposes, may cost more per year than the running water from the city mains. Such a tank is also costly if made durable in the first instance, and can seldom be placed between the floor and ceiling, but must go up through two stories or else be of excessive diameter.

A cooling system has been developed within the last few years, however, that seems to meet all of the requirements for the efficient cooling of even the largest engines, and which

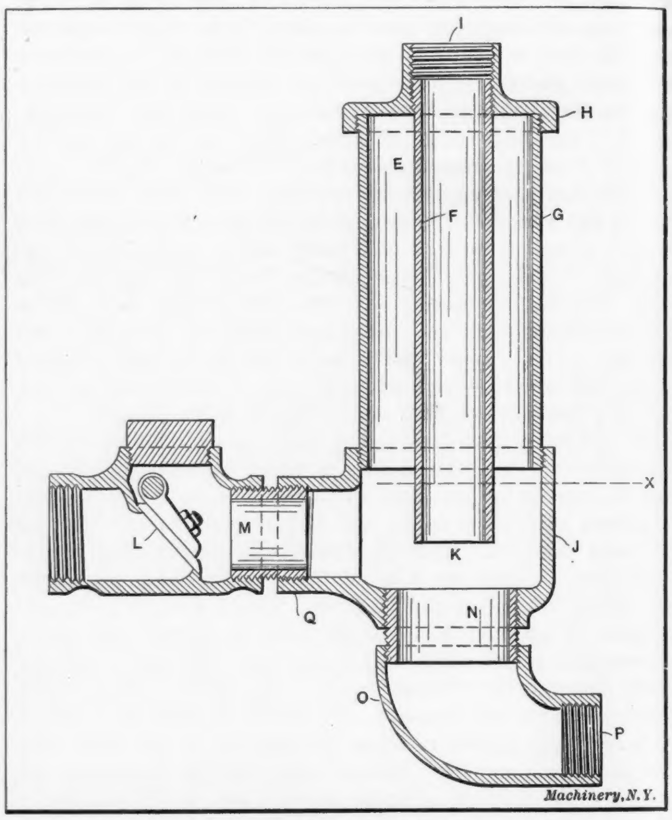


Fig. 2. Small Pump made from Malleable-iron Fittings

does not entail any cost of maintenance when once installed; it also economizes space, as it does not require any more room than that occupied by the engine. It can generally be put in ready to run for a cost which is less than the water bill for one year when the engine is cooled by city water, and it is considerably cheaper to install than the large tank of equal cooling capacity which is necessary for the natural or thermo-syphon method.

This system has been in operation on a 25-horsepower gas engine for about three years, which is used for supplying power in a novelty factory. In this particular instance the demands on the engine are very fluctuating. Sometimes the engine runs for days at a time on full load, and then at other times the load will be comparatively light. The change in the load is partly due to the sudden demands for full power, caused by putting buffing wheels into operation in the nickel plating department. The new method has given no trouble whatever, and in addition to its adaptability for use with stationary gas engines, it also seems to be particularly suitable for service in connection with portable farm engines, such as are used for threshing machines, or in fact for use with any type of gas or gasoline engine using water to keep it cool. The actual waste of money for water, however, is not the only thing to consider with engines as they are at present cooled. It is a well-known fact that in running on variable loads with a constant stream of water passing through the jacket of the cylinder, the engine will consume more gas than it should, owing to being too cold, as the stream of water must be large enough to keep the cylinder sufficiently cool when the engine is working at its full capacity; and when it is running light the same stream makes it too cold to work efficiently, and there is an undue consumption of gas. When the load is thrown

* Address: 33 Wallace Place, Newark, N. J.

on, it takes considerable time for the cylinder to warm up to the point where it can give the greatest power efficiency, consequently it seems that a waste of fuel appears to be unavoidable where running water is used for cooling purposes. With the thermo-syphon system the waste of gas is less, as the temperature of the cooling water and the water jacket surrounding the cylinder is kept more uniform, but besides the objections heretofore named, it gets so hot as to generate quantities of steam, which must be conducted outside at considerable expense, and the connections, and even the water in the tank, are likely to freeze in winter. A simple and efficient pump requiring no attention and consuming no power from the engine shaft, is the keystone to the new system. Fig. 1 shows a diagram of the pump, stand pipe through which it derives power from the engine exhaust, and a section of the delivery pipe. While the pump works from pressure derived from the exhaust gases of the engine, none of the exhaust goes with, or comes into contact with the water to be pumped. It is composed of an air chamber *A*, intake check valve *B*, delivery check valve *C*, the stand pipe *D*, and delivery pipe *E*. The lower end of the stand pipe extends into the pump, so as to form the annular air chamber *A*. To illustrate the operation, it will be assumed that the apparatus is filled with water until the latter rises up in the stand and delivery pipes to about the line *F*. If sudden gaseous pressure is now applied in the pipe *E*, and instantly released, the water will jet from the top *G* of the delivery pipe *E*. At the same time the valve *B* will be heard to click, and if the hand is wet, and quickly applied over the outer opening of the valve, a considerable suction will be felt. Immediately after the pressure is applied, the water will again rise up in the stand pipe, following the click of the valve, to the same level it was before the beginning of the operations. The reason for this action is as follows:

When the pressure is exerted on the column of air above the water in the stand pipe, it causes a downward thrust of the water, which compresses the air in the chamber *A*, and also forces the water out of the delivery pipe *E* at *G*. When the air chamber re-acts it throws the water into the stand pipe and upward with nearly as much force as that exerted by the pressure in the first instance, and as the valve *C* will not allow the vacuum thus formed in *A* to be released, the valve *B* opens, and inspires sufficient water to restore the equilibrium. This cycle of operations takes place in an exceedingly short space of time, but investigations scientifically conducted have shown that this is the action. It will be seen that to make a practical working pump all that is necessary to do is to connect the valve *B* to a water supply, and the stand pipe *D* to a source of intermittent pressure such as the exhaust of an engine.

Fig. 2 shows a pump made of malleable-iron fittings screwed together. The nipple *F* is screwed into the reducer *H* on the inside, while the lower end of the stand pipe is screwed in at *I*. The chamber thus formed must be perfectly air-tight; therefore, it is best to take a cut out of the reducer in a lathe, and after the nipple *G* is screwed in, run melted solder into the top, having previously wet the surfaces with a soldering fluid. The swing check valve *L* is united to the reducer *J* by a close nipple *M*, and the elbow *O* is joined to the bottom of the pump by the close nipple *N*. For an engine of say 10 horsepower, a one-inch stand pipe and a one-inch intake valve are large enough, while the nipple *G* may be made five inches long by three inches in diameter. It will be seen that anyone knowing how to use a Stilson wrench, and who is familiar with pipe fitting can make a pump very quickly and at small expense. A pump of this size has lifted a 3/4-inch stream of water 20 feet high with the exhaust pressure of a 10 horsepower gas engine. While this pump has a suction corresponding to the pressure applied to the stand pipe from the exhaust, it is not capable of drawing water from a deep well, and where a well is used or a cistern is available, the pump should be lowered down to the water level, or considerably below it. Pumps of this class have been found to work even better under these conditions, which necessarily involve the use of a longer stand pipe, than when used above the water. Where the water is to be forced through a long pipe, and to a radiator, it is advisable to use a check valve on the delivery pipe, but where the pipes are short, only the intake valve *L* is necessary. This is illustrated in Fig. 3 where a 5-horsepower vertical gasoline engine is shown running at 350 revolutions per minute. The water is being lifted about 4 1/2 feet above the tank, and after passing through the water jacket of the engine cylinder, it may be seen pouring down into the tank *A* at the left of the illustration, at the rate of about three gallons per minute. The tank holds only about six gallons, yet, owing to the exposure of the water to the air in its descent down into the tank, the engine is efficiently cooled. The pump works equally well on governed engines where the exhaust valve is held open for longer or shorter periods, or on those using a carburetor and controlled by a throttle. In the latter case, however, some engineering judgment must be used as to the height of the stand pipe, or when the throttle is nearly closed water is liable to be drawn over into the exhaust pipe.

The initial illustration of this article shows a pump as it actually appears made up of fittings, and ready to be connected to the stand pipe, which, in turn, is connected to the exhaust pipe of the engine.

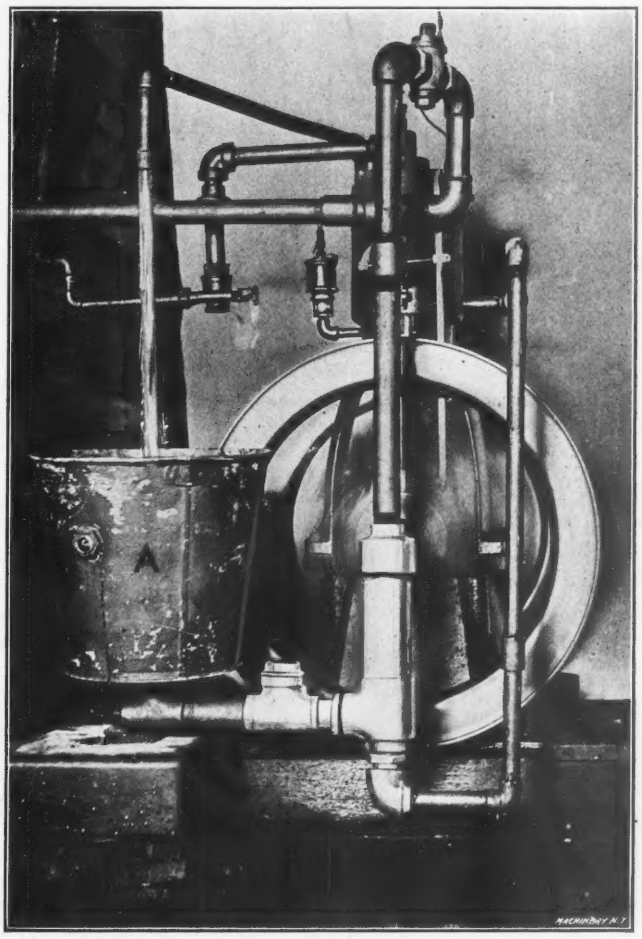


Fig. 3. Five-horsepower Gasoline Engine equipped with Cooling Device

Fig. 4 shows the arrangement of the 25-horsepower plant mentioned in the beginning of this article. One of the flywheels has been removed in order to give a clearer view of the end of the radiator, which is of the same type as those used on automobiles. It will be noticed in Fig. 3 that the pipe connecting the top of the stand pipe with the exhaust pipe of the engine is carried up higher than the top of the engine cylinder. This is done so that the suction cannot draw water over in the exhaust pipe as it might otherwise do, owing to the vacuum contained therein, particularly if the exhaust pipe is long. In Fig. 4 the stand pipe is shown connected to the exhaust pipe by a tee-fitting *E*, and the entrance of the stand pipe into the exhaust pipe is several inches higher than the line *F*, which represents the highest water level when the expansion tank is full. The flywheels of the engine act as fans for the radiator, and the temperature of the water never rises above 212 degrees F. It is generally about 150 degrees. The cold water from the bottom of the radiator is taken by pipe *B* to the intake check valve *L* of the pump, and

from there forced through the delivery pipe which in this case has a check valve *A*. It then passes up through the water jacket of the engine and comes out at the top into the expansion tank, which is kept about half full of water by adding to it from time to time, to make up for the small amount lost by evaporation. As the water gets hot it expands and so increases in volume that the tank will be nearly full when the engine is doing heavy duty and, therefore, developing the most heat. From the tank a pipe runs to the top of the radiator as shown. This pipe is 3/4 inch, while the pipe running from the bottom of radiator to the pump is 1 inch. At *C* a plug is provided to draw the water off, which is done about once a week, fresh water being put into the system through the expansion tank. During severe weather in winter the engine jacket and piping is drained every night, and refilled in the morning which is not a serious undertaking, as the whole quantity of water used is only a few gallons.

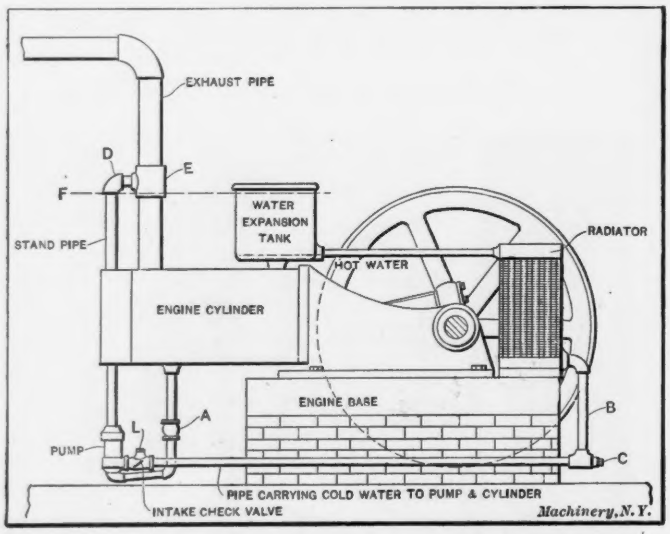


Fig. 4. Arrangement of Cylinder-cooling Device for a 25-horsepower Plant

The water for cooling this engine formerly cost over $125 per year. The present outfit has been running at no cost whatever, excepting $4 paid for repairs to the radiator, thus making a net saving of $371 for the three years, to say nothing of the saving in gas due to the more uniform temperature at which the engine cylinder has been kept. The first cost of installation was $108, most of this being for the large radiator used which has since been found of a capacity considerably in excess of the requirements. This system of circulating water should commend itself to manufacturers of farm engines as it does away with the large and heavy tank now used, which it would seem must cost as much or more than an automobile radiator of equal cooling capacity. The pump used with an automobile engine is quite costly to manufacture as compared with the pump herein shown, besides taking considerable power from the engine shaft to drive it. The power derived from the exhaust to operate these pumps cannot, of course, be applied to any other useful purpose, and it may be stated that they cost nothing to operate, while the cost for lubricating oil, for repairs and financial expenses, are much less with the exhaust-operated system than with any other now in use.

* * *

The rapid elimination of the sailing vessel is indicated by the fact that the percentage of this class of vessels in the merchant marine of Great Britain declined from 1888 to 1908 from 44.1 to 12.6. The decline in the German merchant marine was from 62.1 to 19.1 per cent, and in that of the United States from 80.7 to 30.9 per cent.

* * *

A record for efficiency of hydraulic turbines has recently been obtained in tests which were undertaken with the 10,000-horsepower turbines at the Trollhättan power station in Sweden. The efficiency was found to be 86 per cent for the turbines furnished by the firm of Nydqvist and Holm, Trollhättan. The highest efficiency hitherto obtained anywhere, as far as known, is 85.7 per cent.

GRINDING GAS-ENGINE CYLINDERS

By JOHN F. WINCHESTER*

In the editorial in the July issue of MACHINERY you made some pertinent remarks in regard to the grinding of automobile cylinders. Having had considerable experience on this class of work in various shops, I would like to give my views upon this timely subject, which may be of interest to your readers.

Ten years ago, refinement in cylinder bore finish was accomplished either by lapping with a dummy piston or with an alloy of the expanding type, both processes being slow and unsatisfactory even at their best.

Grinding was little done on this work, partly due to the limited knowledge of this branch of the industry, and also on account of the poor grinding machines obtainable for this class of work. But when the machine tool makers realized the importance of the gas engine business they immediately commenced to design machines for this special purpose, and up-to-date mechanics and managers seeing a chance to make a more accurate cylinder at a smaller cost took up with the idea. They not only produced a cylinder of greater refinement at a lower cost, but also made a talking point of the operation when selling their product.

There are many mechanical men who will say that reaming gives as good results, and at a lower cost. This may be true of a lower-priced engine where engineering refinement cannot be sought for, and where quantity and not quality counts. But with the other class of engines where specifications call for a rough bore within 1/64 inch of size, and the setting aside of the cylinder to "season", the grinding of the cylinder produces much better results. In other words, reaming has its place in the case of a cheap engine, but outside of that, grinding is by far the better operation. It insures greater interchangeability with less supervision than is required in reaming. The best practice in cylinder reaming is to ream in a vertical machine, a boring mill, radial drill, or any special machine of this type, as the reamer generates less heat, stands up longer and gives a more perfect finish than can be obtained in a horizontal machine. In reaming cylinders, a careful man with a watchful eye is required to prevent the reamer striking the head of the cylinder, which makes the reamer cut large and out of round at the most important point of the bore. An observant eye must be kept on reamers to see that they keep their size and cut properly, whereas for grinding it takes no longer to set the cylinder up than for reaming, and the operator can look after his wheel, keeping it in proper shape, and can also duplicate work with little trouble from the shop or toolroom.

At this juncture it may be interesting to note that any machine or discarded tool cannot be fitted up with grinding attachments and yet give good results. An instance of this fact came to my attention some time ago. The firm for which I worked at the time had contracted to build a number of gasoline engines, the bore of which was to be ground to size. Work was started and the cylinder was being bored and reamed when the inspector for the engine firm came along and insisted upon the cylinder being ground as the contract called for. Not having any grinders for this class of work, old lathes were fitted up with grinding attachments with the following results: The bore was not as true as when done with a reamer, showing high and low spots throughout. Nevertheless, the work passed inspection as it had been ground. in that case quality, and I think quantity, had been sacrificed to give the salesman a talking point for his engine.

Some of the best cylinders I have seen have been finished by boring within 1/64 inch of size, baking over night to relieve foundry strain and then grinding to size. These we produced in a shorter time than by reaming, but in the running qualities of the motors about the same results were produced by the reamed and ground cylinders.

* * *

Don't fail to clean away all dirt and chips before screwing a chuck or faceplate on the lathe, and if the screw is dry, put on a few drops of oil.

* Address: 215 Park Place, Brooklyn, N. Y.

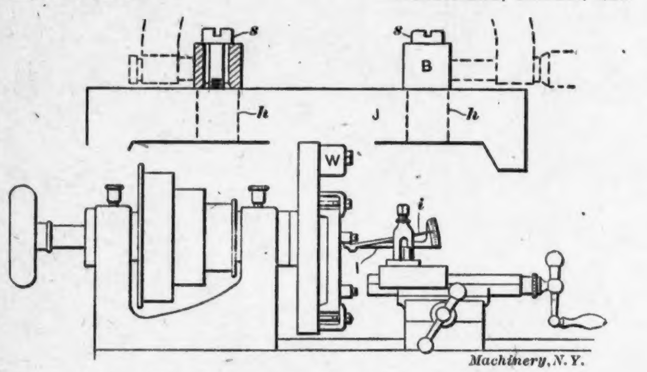
Supplement to MACHINERY, October, 1910

Supplement to MACHINERY, October, 1910

Operations for the Article in this number entitled "Machine Shop Practice—Locating Work by the Button Method"

SHOP OPERATION SHEET NO. 148

Franklin D. Jones MACHINERY, October, 1910



Locating Work by the Button Method

NOTE.—When it is necessary to bore holes with great accuracy as to location, the button method, which is the one commonly used on jig work, is employed. The method consists, briefly, in locating cylindrical bushings, or buttons *B*, exactly central with the holes to be bored and setting the work on the faceplate in the correct location for boring each hole, by the buttons. As the position of the bored holes is governed entirely by the buttons, the location of the latter is of great importance. As a simple illustration of this work, we shall assume that two holes *h* need to be bored in the jig-plate *J*, which has been previously finished on the top and sides.

1. First lay off the centers of all holes to be bored, approximately correct, by the usual method. Mark these centers with a prick-punch, and then drill and tap holes for the machine screws *s* which are used to clamp the buttons.

NOTE.—The buttons should be ground and lapped to the same size and the ends finished perfectly square. The outside diameter should preferably be such that the radius can easily be determined, and the hole should be about 1/8 inch larger than the screw so that the button may be shifted.

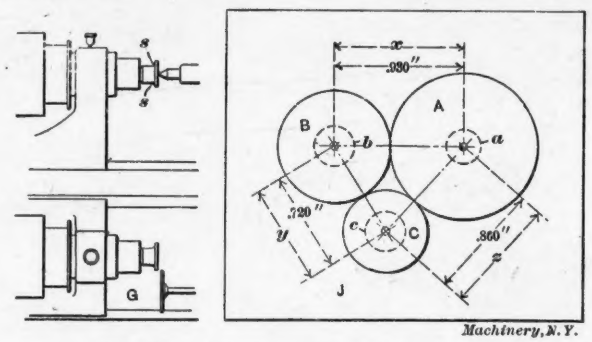
2. Clamp the buttons lightly and set them in correct relation with the sides of the jig. This can be done by placing first one and then the other of the finished sides from which the buttons are to be set, on a surface-plate and measuring with a Vernier height gage. The center-to-center distance can be verified by measuring with an outside micrometer, as indicated by the dotted lines. When the buttons are accurately set, clamp them tightly and then take a final measurement.

3. Clamp the work to a lathe faceplate (bench lathe is preferable for small work) and set one of the buttons true by using a test indicator *I*. When the inner end of the indicator is brought into contact with the revolving button, the vibration of the pointer *i*, shows which way the work should be shifted. When one button is set practically true, remove it and bore and ream the hole. In a similar manner finish the remaining hole.

NOTE.—When work being bored is set off center, as illustrated, the faceplate should be balanced by a counterweight *W*, as otherwise centrifugal action will tend to cause inaccuracy when the lathe is speeded up for boring.

SHOP OPERATION SHEET NO. 149

Franklin D. Jones MACHINERY, October, 1910



Locating Work by the Disk Method

NOTE.—Comparatively small precision work is sometimes located by the disk method, which is the same in principle as the one described on the preceding sheet, the chief difference being that disks are used instead of buttons. These disks are made to such diameters that when their peripheries are in contact, each disk center will coincide with the position of the hole to be bored; the centers are then used for locating the work. To illustrate this method, let us assume that the jig-plate *J* (see engraving) is to have three holes (*a*, *b* and *c*) bored in it to the center distances given.

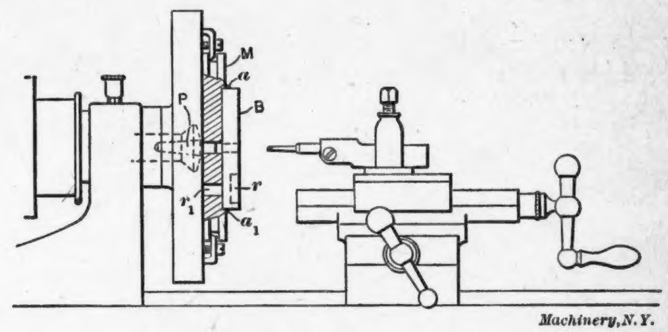
1. Before the disks can be made, it is first necessary to determine their diameters. If the center distances between all the holes were equal, the diameters would, of course, equal this dimension. When, however, the distances between the centers are unequal, the diameters may be found as follows: Subtract, say, dimension *y* from *x*, thus obtaining the difference between the radii of disks *C* and *A*; add this difference to dimension *z*, and the result will be the diameter of disk *A*. Dividing this diameter by 2 gives the radius, which, subtracted from center distance *x*, equals the radius of *B*; similarly the radius of *B* subtracted from dimension *y* equals the radius of *C*. Having the radii, the diameters are, of course, easily obtained. For example, $0.930 - 0.720 = 0.210$ or the difference between the radii of disks *C* and *A*. Then the diameter of $A = 0.210 + 0.860 = 1.070$ inch, and the radius equals $1.070 \div 2 = 0.535$ inch. The radius of $B = 0.930 - 0.535 = 0.395$ inch and $0.395 \times 2 = 0.790$, or the diameter of *B*. The center distance $0.720 - 0.395 = 0.325$, which is the radius of *C*; $0.325 \times 2 = 0.650$ or the diameter of *C*.

2. After determining the diameters, the disks should be turned nearly to size and finished preferably in a bench lathe. First insert a solder chuck in the spindle, face it perfectly true, and attach the disk by a few drops of solder as at *s*, being careful to hold the work firmly against the chuck while soldering. Face the outer side and cut a sharp V-center in it; then grind the periphery, as at *G*, to the required diameter.

3. Fasten the finished disks on the jig-plate (in their correct location and with their peripheries in contact) by applying a mixture of melted beeswax and rosin (in about equal proportions) to the sides. When this has hardened, attach the work to the faceplate, and set it for boring each hole by using a center indicator in the disk centers.

SHOP OPERATION SHEET NO. 150

Franklin D. Jones MACHINERY, October, 1910



Locating Work by a Master-plate

NOTE.—When it is necessary to machine two or more plates so that they are duplicates, as to the location of holes, circular recesses, etc., what is known as a master-plate is often used for locating the work on the lathe faceplate. This master-plate *M* contains holes which correspond to those wanted in the work, and which accurately fit a central plug *P* in the lathe spindle, so that by engaging first one hole and then another with the plug, the work is accurately positioned for the various operations. Precision work of this kind is done when possible, in a bench lathe.

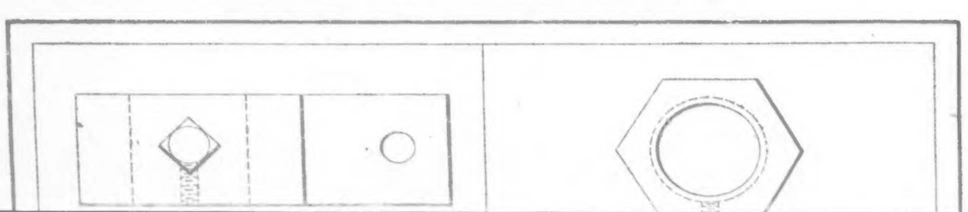
1. When making the master-plate, great care should be taken to have the sides parallel and the holes at right angles to the sides. The various holes may be located with considerable precision by the use of buttons or bushings as described on Sheet No. 148. Of course, it is necessary to have a hole in the master-plate for each different position in which the work will have to be placed on the faceplate; for example, if a circular recess *r* were required, a hole r_1 exactly concentric with it, would be needed in the master-plate. The method of holding the work and locating it with reference to the holes in the master-plate will depend largely on its shape. The cylindrical blank *B* illustrated, is positioned by a recess in the master-plate in which it fits, and it can be held by soldering at various points as at *a* and a_1. Clamps and dowel-pins or screws are, however, more often used.

2. The plug *P* which locates the master-plate, is first turned to fit the spindle or collet of the lathe and the outer or projecting end is rough turned for the holes in the master-plate; it is then inserted in the spindle and ground and lapped to a close fit for the holes in the master-plate. The latter, with the work attached to it, is then clamped to the faceplate by the straps shown, which engage a groove cut for the purpose.

3. The first hole is finished by drilling to within, say, 0.005 or 0.006 inch of the size, and then boring practically to size, a very small amount being left for reaming. The remaining holes can then be finished in the same way, the work being positively located in each case by loosening the master-plate and engaging the proper hole in it with the central plug. It is apparent that by the use of this same master-plate, a number of pieces *B* could be made which would be practically duplicates.

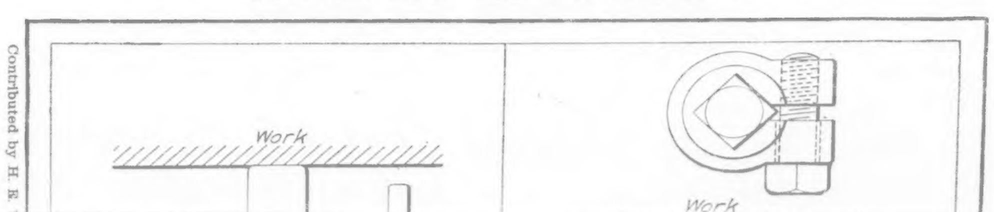
PLANER AND SHAPER JACKS—II

Contributed by H. E.



PLANER AND SHAPER JACKS- I

Contributed by H. E.



PLANER AND SHAPER JACKS- I

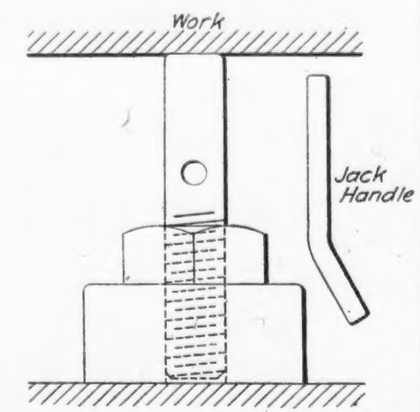


Fig. 1. Simple type of planer jack, with check-nut to prevent stud from jarring loose when taking the cut.

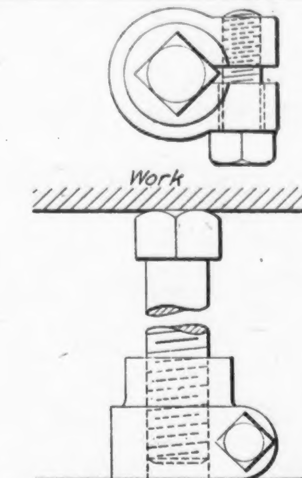


Fig. 2. Planer jack consisting of a square-head screw and a split lock-nut with binding screw.

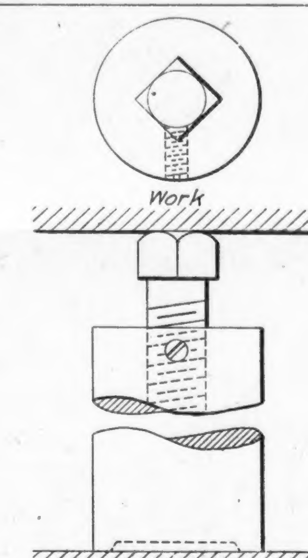


Fig. 3. Planer jack consisting of a piece of round stock and a square-head screw.

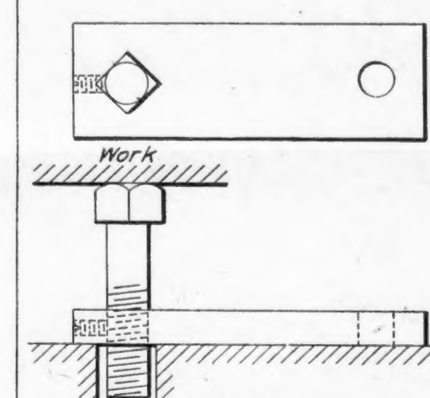


Fig. 4. Planer jack made of a flat piece of stock and a square-head screw, the end of which enters a hole or T-slot in planer table.

Contributed by H. E. Wood

PLANER AND SHAPER JACKS—II

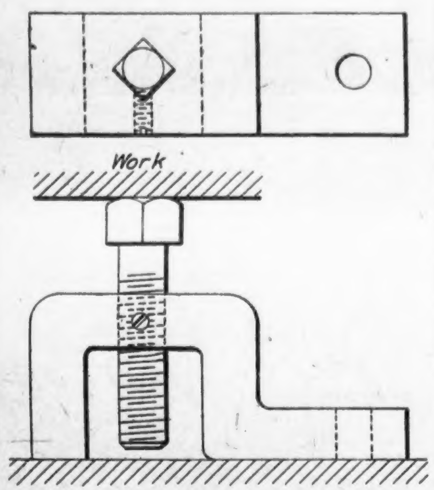


Fig. 5. Planer jack made of a bent piece of flat stock and a square head screw.

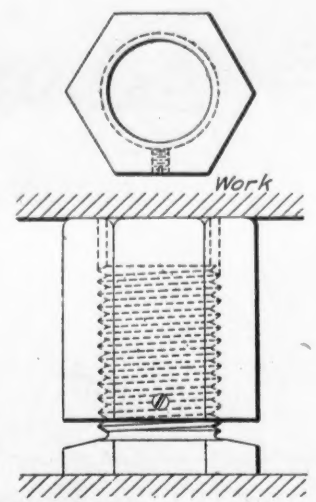


Fig. 6. Planer jack made of two pieces of hexagonal stock, with binding screw.

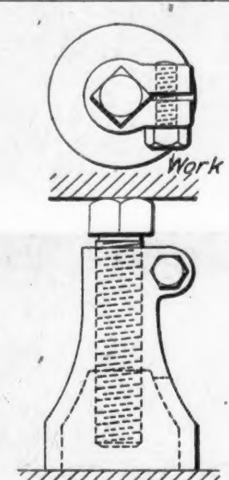


Fig. 7. Cast base planer jack with binding arrangement.

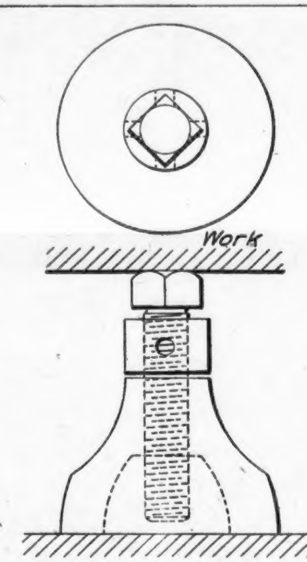


Fig. 8. Cast base planer jack with binding nut.

Contributed by H. E. Wood

PLANER AND SHAPER JACKS—III

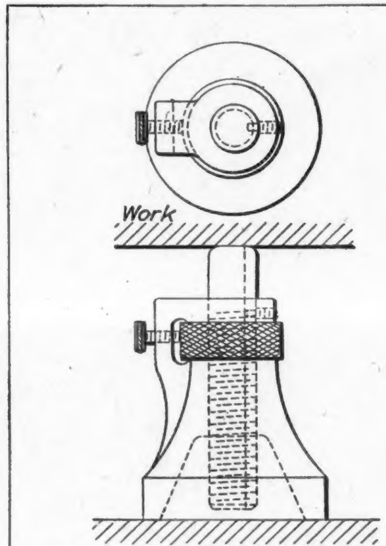


Fig. 9. A planer jack in which the threaded stud or ram does not revolve.

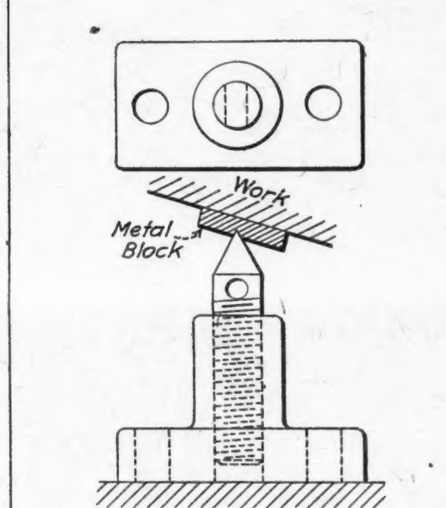


Fig. 10. A planer jack especially intended to support work surfaces at an angle with the plane of the planer table.

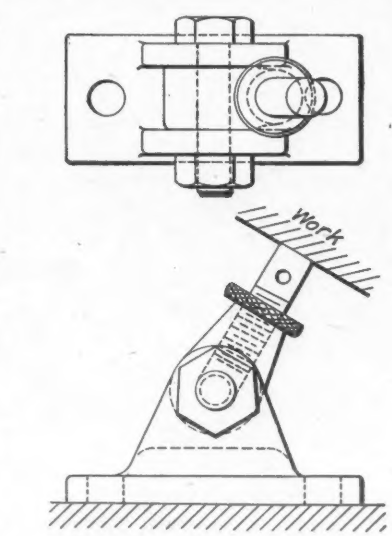


Fig. 11. A planer jack with swiveling ram for angular work.

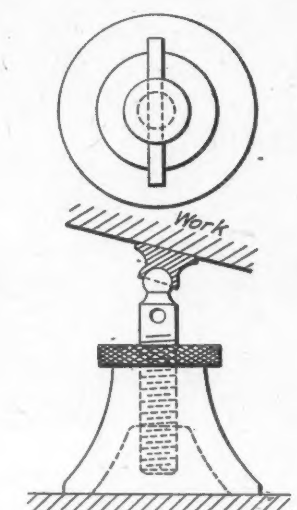


Fig. 12. Planer jack with swiveling cap permitting adjustment to any inclined surface.

PLANER AND SHAPER JACKS—IV

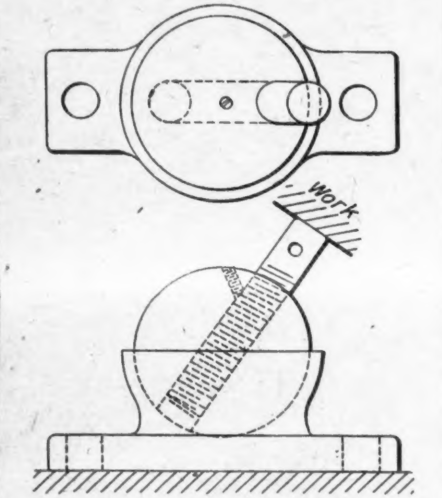


Fig. 13. Universally adjustable planer jack of the ball and socket type.

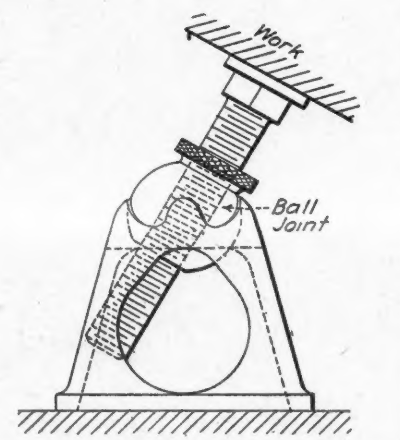


Fig. 14. Ball and socket planer jack with locking nut.

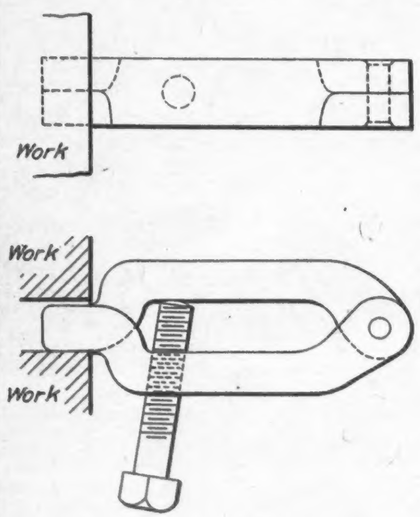


Fig. 15. Jack used for prying apart pieces of work.

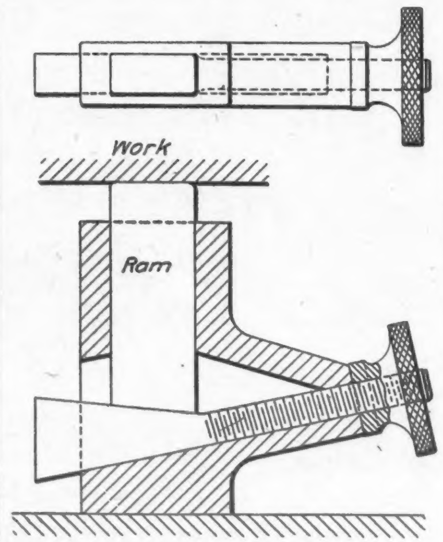


Fig. 16. Special wedge type jack used in narrow spaces.

PLANER AND SHAPER JACKS*

By H. E. WOOD†

In many respects the planer jack is as important a tool as any around a planer or shaper. Many pieces of work of more or less irregular character cannot be supported properly or clamped adequately in place without the use of some form of planer jack. Not only is it of importance that mechanics in general are familiar with the simpler forms of planer jacks, so that they can easily make one at short notice when required, but the regular tool-room of the machine shop should be provided with a large assortment of different types of appliances of this kind, because a great deal of time which otherwise would be lost, can be saved in this way. Many of the forms of planer jacks shown in the accompanying Data Sheet Supplement are more or less familiar objects to most mechanics, but some of them may present ideas that are new to many.

The planer jack shown in Fig. 1 of the accompanying Data Sheet Supplement, is one of the simplest in form, consisting simply of a block having a drilled and tapped hole and a piece of round bar stock threaded on one end. A check nut is provided to prevent the stud from jarring loose when the cut is taken, and a hole is drilled through the bar so that a jack handle, as shown to the right, may be inserted for turning the bar when adjusting it. Fig. 2 shows another simple planer jack consisting of a square-headed screw and a split lock-nut, the latter being provided with a binding screw. When this planer jack is being adjusted to height, the lock-nut binding screw is loosened; as soon as the correct height has been obtained, the binding screw is again tightened, thereby preventing any motion of the screw in the nut, due to vibration or other causes. Fig. 3 shows another simple form of planer jack consisting merely of a piece of round stock, drilled and threaded for the required distance from one end, for the square-headed screw inserted into it. A small headless set-screw can be used for binding the square-headed screw. As it is not advisable to have the binding screw bind directly against the threads of the square-headed screw, a small piece of brass should be inserted between the threads in the large screw and the end of the set-screw. It is also advisable to relieve the large stud at the lower end, so that it has a bearing only around the edges, as shown in the illustration. This prevents it from rocking on the planer table if the end should not be perfectly square.

Fig. 4 shows a planer jack made of a piece of flat stock and a square-headed screw, the end of which enters into a hole or T-slot in the planer table. A hole is drilled at the other end of the flat piece of stock. This makes it possible to clamp it to the planer table when necessary, to avoid shifting or sliding. A small headless set-screw is provided, as shown, for locking the elevating screw, to prevent it from moving when once set. Fig. 5 shows a planer jack which is similar in principle to the one shown in Fig. 4, but the piece of iron in this case has been bent so that the elevating screw can be adjusted up and down without being required to enter a hole or slot in the planer table. This planer jack has, therefore, a larger range than the one previously shown. Fig. 6 shows a more elaborate type of planer jack, which, however, is a good form for many pieces of work, when a strong support is required. It is made of two pieces of hexagonal stock, one being turned and threaded as indicated; a set-screw is provided, as shown, for locking the screw to the nut.

In Fig. 7 is shown a planer jack having a cast base. This form of device is in common use. The cast base is split for some distance down, and a binding screw provided, so that the correct setting can be preserved. In Fig. 8 is shown another cast-base planer jack which is very similar to the one shown in Fig. 7, except that the locking device consists of an adjusting collar or nut binding directly against the top of the base. In Fig. 9 is shown a planer jack of the cast-base type possessing a feature which makes it preferable in many instances to the two types just shown. In this planer jack the ram or central stud moves up or down without a rotating movement. The adjustment is secured by turning the knurled nut shown. The small knurled-head screw at the left binds against the knurled nut and prevents motion after the proper adjustment has been obtained. The headless set-screw at the right enters a groove or keyway in the ram, thus preventing it from turning with the nut.

In Fig. 10 is shown a planer jack especially intended for supporting work having a surface at an angle with the plane of the planer table. It is made with a cast base with holes provided for bolting it down to the planer table for preventing it from sliding or overturning. A small metal block is inserted between the work and the upper end of the pointed elevating screw. This block prevents the screw point from marking or injuring the work surface. Fig. 11 shows a planer jack which also is intended for supporting work surfaces which are at an angle with the plane of the planer table. In this construction, however, the range of the device is considerably increased by having the block, into which the ram screws, swivel around a pivot in the base. In fact, this planer jack, when properly clamped down, can be used for supporting surfaces that are at right angles with the planer table.

Fig. 12 shows a planer jack to be used for supporting work with inclined surfaces. Here, the swiveling joint permits the supporting surface of the cap to adjust itself freely to the position of the work. In Fig. 13 is shown a universally adjustable planer jack of the ball and socket type. It possesses some advantages over the types shown in Figs. 11 and 12 in that it can be rotated in any direction relative to the base. One of the disadvantages of this particular construction, however, is that no means are provided for locking the sphere in place. In Fig. 14 is shown another universal adjustable planer jack. It differs from that shown in Fig. 13 merely by the introduction of a locking nut at the top of the ball.

Fig. 15 shows a jack used for prying apart pieces of work where it is necessary to be careful not to mar the edges or bruise them by the use of other tools. The jack-screw, in this case, is at an angle with the center line of the device when this is closed, so that when opened to various positions, it will bear against the opposite jaw at approximately a right angle. If it were placed at right angles to the opposite jaw when the device is closed, it would form too acute an angle with this jaw as the device was opened. This would impair the efficiency of the piece and mar the threads at the edges of the point of the screw. Fig. 16 shows a special wedge-type jack-screw used in narrow places. It consists of a ram actuated by the wedge-shaped end of the adjusting screw. The construction is clearly shown in the illustration.

Any shop which provides itself with a first-class collection of planer jacks of these or similar types, and provides for a proper place for keeping them, to which they are returned after having been used, will find that a great economy of the men's time will result. In many classes of work the time lost in hunting for suitable tools, clamping straps, jacks, arbors, etc., is a greater factor than is the actual cutting work on the piece to be made, and besides, with inferior clamping and supporting devices, the work itself is often not as satisfactory when completed as it would have been if proper facilities were provided.

* With Data Sheet Supplement.

† Address: 182 North Fourth St., Newark, N. J.

* * *

AMENDMENTS TO THE LABOR LAW OF NEW YORK

Chapter 352 of the laws of 1910 of New York State entitled: "An Act to Amend the Labor Law, in Relation to Employers' Liability," increases the liability of employers as follows:

1. *The "fellow servant" rule is greatly modified.*—The fellow servant rule of law, which relieved employers from liability for accidents caused by an act of a fellow workman of the injured workman, is amended so that hereafter the employer is liable for the act (causing an accident) of any person in his employ when such person is intrusted with any superintendence or intrusted with authority to "direct, control or command" any employe, thus greatly increasing the employer's liability, as it brings within the scope of the amended law a large percentage of all accidents.

2. *"Assumption of risk" abrogated.*—The amendment does away with the rule of law of "assumption of risk," under which a workingman by continuing at work with knowledge of dangerous or defective conditions, was held to have assumed the risk and therefore was not entitled to recover damages resulting therefrom. All work necessarily involves

risk of injury to the workman, but the rule which has always heretofore been the law—that if the workman understood his work he assumed the consequences, no longer exists. This reversal of the old rules adds much to the employer's liability. Probably more accidents come with this class than with any other.

3. *"Contributory negligence"; burden of proof placed on the employer.*—The rule of law (previous to this amendment) was that a workman who was guilty of contributory negligence, however slight, in connection with an accident, could not recover damages for injuries even though the accident was due to the negligence of the employer. Heretofore in all such cases, the workman has been required to prove affirmatively not only the negligence of the employer but that he, on his part, was wholly free from any and all contributory negligence. The law as amended changes this rule and places upon the employer the burden of proving the contributory negligence of the workman. The new law assumes, in the absence of affirmative proof to the contrary, that the injured workman exercised due care to prevent the accident by which he was injured. This amendment will enable the workman to recover in cases where affirmative evidence as to his negligence is lacking, and will be especially useful to the workman's family in death cases where the injured workman by reason of his death is unable to testify and there may not be any living witness of the accident. It must be borne in mind that in death cases, if damages are recovered, they are for large amounts, consequently this amendment will very greatly increase the total amount of damages to be paid by employers.

4. *Defects for which the employer is now liable for damages.*—The old law made the employer liable for damages arising from accidental bodily injuries caused by defects in "the ways, works or machinery" used in his operations. The law is amended by the addition of the word "plant." This amendment makes the employer liable for many accidents to his workmen for which he has heretofore not been liable.

5. *Notice of accidents.*—The act amends the provision of the old law requiring specific service on the employer of a notice of the "time, place and cause" of the accident, by providing that unless such notice to the employer, if defective, is returned by the employer to the injured workman within eight days with a demand for a further notice, which demand must specify the particulars in which the first notice is claimed to be defective, the employer shall be considered as having waived all defects in the first notice. This new provision practically abolishes the hitherto important defense of lack of proper notice.

This law went into effect September 1; also two additional laws creating a new kind of liability for employers. These two additional laws, known as workmen's compulsory compensation law and alternative or permissive compensation plan respectively, introduce in this country an entirely new doctrine as respects the obligation of employers to employes, *i. e.*, the doctrine of compensation to the injured employe, irrespective of the question of negligence, as distinguished from the old doctrine of "damages" to the employe because of the negligence of the employer.

* * *

IMPROVED METHOD OF DIMENSIONING JIGS AND FIXTURES

By JIG AND TOOL DESIGNER

The making of templets, fixtures and jigs, is generally considered accurate work, and the name given to this class of work is toolmaking. The construction of the jigs calls for as great accuracy as any branch of the toolmaker's business, but the accuracy with which the jig should be constructed depends entirely upon the nature of the work to be accomplished, and yet, if the work is within the limit of 1/16 to 0.0005 inch, the drill bushings or locating points should be laid out as accurately as possible, for any inaccuracy in the jig will, of necessity, be duplicated in the work. At the present time, especially in large factories, the toolmaker is guided in the making of a tool by a drawing, and the drawing and designing of jigs and fixtures has become a science in itself. Yet many draftsmen in this line of work, make the work of the toolmaker more difficult and less accurate by giving radial dimensions, or by working from succeeding points instead of always working from a center-line. In Fig. 1 is shown the correct method of dimensioning drawings. This is a simple jig for drilling an automobile gear case cover, the cover being clamped as shown. The dimensions are laid off from a center-line and measured in a straight line from every important point, and are given in thousandths, or fractions as the case may require. Fig. 2 shows the same jig with dimensions improperly arranged. It is easy to see that a toolmaker can work from straight dimensions, or from points that are at

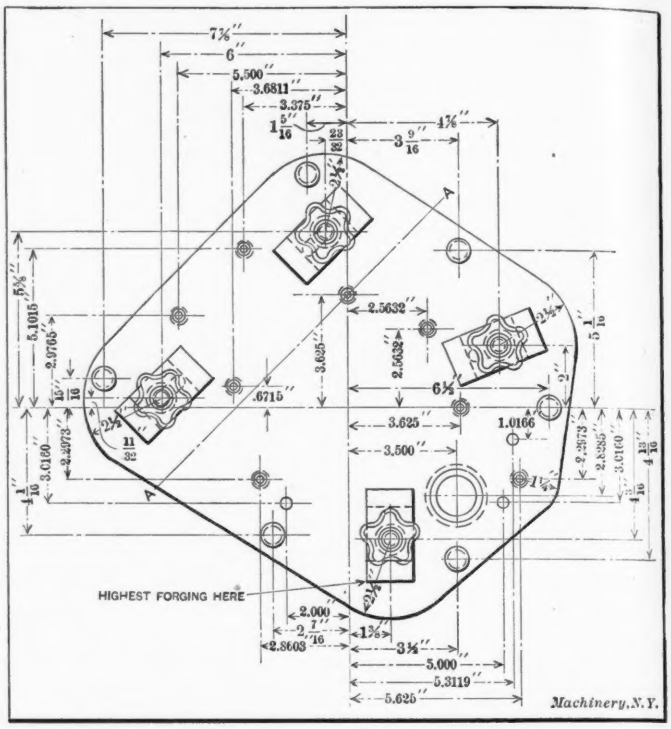


Fig. 1. Correct Method of Dimensioning Drawings

right angles to each other, by using the micrometer dial on the milling machine, the micrometer, micrometer calipers, vernier, etc. When the jig is laid out as shown in Fig. 2, the toolmaker often has to figure the dimensions all over

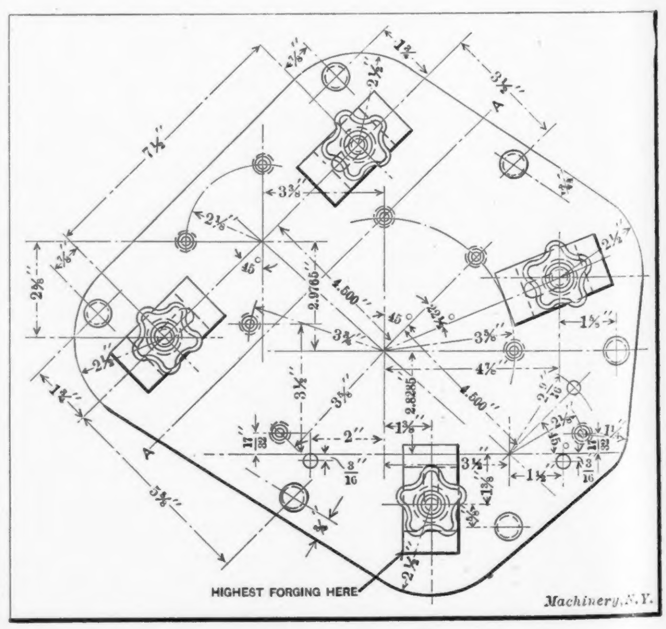


Fig. 2. Incorrect Method of Dimensioning Drawings

again or have some one do it for him, while the draftsman is supposed to understand trigonometry, etc., and could have easily given the dimensions in the manner which would be the easiest to lay out.

* * *

The excess of exports from the United States over imports to the United States during the fiscal year ending June 30, 1910, was the smallest for any year since 1896. Contrary to the opinions of many people, this is not necessarily an unfavorable condition. It may merely indicate that the indebtedness of the United States to Europe is decreasing, and that a smaller amount of excess of exports over imports is required to pay the interest on foreign investments in America's natural resources and industrial enterprises.

EXPERIENCES OF A YOUNG TOOLMAKER*

By T. COVEY

"Jim," said Mr. Corbin, "Mr. Anderson is making a jig that is too large for one man to handle, and I am going to put you on the job with him. There are also some of the smaller pieces that you may be able to make. You may report to him and help him in whatever way you can."

Jim found Mr. Anderson near a large drill press laying out pin holes in a casting, a view of which is shown in Fig. 1. He had wedged a piece of wood into the hole in the center and was laying out the center of the hole on that; then, using a large square, he scribed two lines through the center terminating at the four sides of the piece; with a smaller square he transferred these lines down the sides of the piece and with a center-punch pricked points at about the center of the thickness of the piece on each line, thus locating the position of the pin holes.

"If you want those holes for finger straps to hold the piece down while planing, why do you need four holes, and why are you so particular where they are?" asked Jim.

"Well," said Mr. Anderson, "as far as planing is concerned, two holes are enough and it would not matter so much where they are, but I think that I will have to put this casting on a boring mill, or the faceplate of a large lathe, to bore out that hole and recess it; in that case, you see it would be very handy to have four holes, and it will also save trouble if they are in the proper place to come in line with the tee-slots in the faceplate when the hole is chucked up central, which they will do as they are now laid out."

"There, the holes are drilled, we will put it on the truck and you can return these tools to the toolroom and then come and help me set it up on the planer."

"Now I suppose that you want some finger straps, don't you?" asked Jim, when he returned.

"They are not necessary," said Mr. Anderson. "I have some 5/8-inch pins about 1 1/2 inch long that I keep in my drawer for use on such jobs as this; it is only necessary to put one of them in a hole and let it project out a half-inch or so, then one can use an ordinary strap on it. Finger straps are all right when they can be found handy, but sometimes it takes longer to find suitable ones than it ought to take to set the job up. The casting rocks a little on the bed; we will have to pack up under these two corners with heavy cardboard. Now we want two straps and five or six stops; we will put one strap at each side and two stops at the end that receives the pressure of the cut; we will also put two stops on one side of the piece and one on the opposite side near the middle."

"Why do you want so many stops?" asked Jim.

"Well, I have found through my experience that when one does not want to spring a piece, the best way is not to strap it down too firmly, especially if the surface next to the table or bed is not perfectly true. The duty of the straps should be to simply prevent the work from lifting off the bed, and not to resist any pressure due to the cut; the stops should take care of that. It is a good plan to loosen the straps a little before taking a finishing cut, and on jobs like this one that are to be scraped down to a surface, it is always best to take a roughing cut off all the surfaces that are to be planed before finishing any one surface. On some jobs it is advisable to rough out all the machine work, even to the lathe and milling-machine work, as in this way any tendency of the piece to warp arising from the removal, or partial removal, of the strains set up in the piece and due to the process of casting or forging, is eliminated, because practically all of these strains are due to a difference in the density of the metal lying on the outer surface of a rough casting or forging and that which composes the interior or body of the piece. For illustration, suppose we have a casting 1 1/2 by 3 by 18 inches and fairly straight; we put it on the planer and take a cut over one side removing approximately 1/8 inch from that surface; then we try a straightedge on this planed surface. The chances are that we will find the edge where the cut started in to be curved convex, and the edge where the cut finished to be fairly straight; while that side from which no cut was taken would be found concave, were it possible to apply the straightedge. Then we put the piece back on the planer and take a cut off the opposite side, after which we remove the clamps and pack up under the piece until it rests evenly on the table of the planer, clamp it lightly and take another light cut over it; then on removing the piece and trying a straightedge again, we will find the side over which the last cut was taken to be fairly straight, that the surface over which the first cut was taken has changed, that the edge on which the cut was started is now fairly straight instead of convex, and that the edge on which the cut finished is now concave instead of straight. This would go to show that the outer surface of the casting was in tension and the interior was in compression, or in other words, the outer surface contained a strain trying to make the piece shorter while the interior contained a strain trying to make the piece longer.

"In the case of the above-mentioned piece, neglecting for convenience the two edges, there were three forces acting on it; one on each side tending to make the piece shorter, and one in the middle tending to make the piece longer. When the piece was a rough casting these forces balanced each other and the piece remained straight, but as soon as we took a cut off one side of it, we removed one of the forces that was tending to make the piece shorter, thus leaving only two forces opposed to each other, and as one of these forces is on one side of the piece and one on the other, they are free to act, which they do, bending the piece so that it is concave on the side on which the strain is tending to make the piece shorter. When we take a cut off the other side we remove the one remaining strain acting to make the piece shorter, therefore leaving the piece free to assume its normal or straight condition.

"Generally a forging or a piece of cold-rolled steel will go in the opposite direction that a casting would, though cold-rolled stock is very uncertain and the strains are not always removed on taking a cut off the outside.

"It has been my experience that these strains exist in nearly all castings to a greater or less extent; for this reason, any piece of work that has to be very accurate when completed should have all the surfaces that are to be finished roughed out before any of the accurate dimensions are completed, else the machining of some unimportant surface might affect the accuracy of important completed dimensions, and, while it might not amount to more than 0.001 or 0.002, inch, it should be taken into consideration where accurate results are required. Of course, the shape of a piece would govern to some extent the amount it would be affected by such strains. Take for instance the piece we are working on; we would be pretty safe to plane up and finish all the surfaces that are to be planed before we bore the hole in the center, because boring the hole would not be likely to affect any of the other surfaces, and if it did the planed surfaces need only be accurate in this manner: the top and bottom must be parallel, and the side that is to be finished must be square to the top and bottom surfaces; the thickness of the piece and the distance of the finished side from the hole is immaterial within reasonable limits, and therefore if boring the hole should affect the accuracy of the planed surfaces it could be remedied without much difficulty.

"Well, I guess that we are about ready to start planing on this now. It seems to be chucked up all right."

"Now, Jim, there are two angle-plates that go to make a part of this jig and you may take them to a shaper and plane them. The only particular part of the job is to get them square. Plane them down until they are about an inch and a quarter thick, and take a fair cut off the ends and sides. The ends need not be perfectly square, but the sides and outside faces should be. Leave a good radius or fillet in the inside corner."

Jim had done quite similar work before and had no trouble in planing the angle-plates in a satisfactory manner, stopping once to help Mr. Anderson turn his piece over, and again when he was called to help get the piece off the planer and into the boring mill department As he was helping to get the piece

* For previous installments of this series of articles, see "Experiences of a Young Toolmaker," with accompanying references, August, 1910.

off the planer, he noticed that one side had been left roughly planed and asked if that was to be the bottom.

"No," said Mr. Anderson, "that is the top. I can finish that to better advantage in the boring mill; it will be the first surface that I finish after I get the hole and recess roughed out. You see, when I get it faced off so that it is parallel to the bottom, it will not be necessary to do any further chucking to get the recess right, as any error that exists will be easy to detect with the micrometer by measuring around the outside of the piece, and even such errors as are shown in this manner would be magnified."

When they got the piece on the boring mill table, Mr. Anderson called Jim's attention to the advantage of having the pin holes drilled in the proper place, it being an easy matter to chuck the piece in position and the results being much better then placing it in chuck jaws. "I will rough out the hole and recess first," said Mr. Anderson, "and then as there will be no more heavy cuts to take, I will loosen the clamps a little and take a light cut off the top, if it comes out parallel, which it should. I will then finish the hole and recess without disturbing the clamping. I guess that I will not need your help for a while, and you can go and finish up your angle-plates."

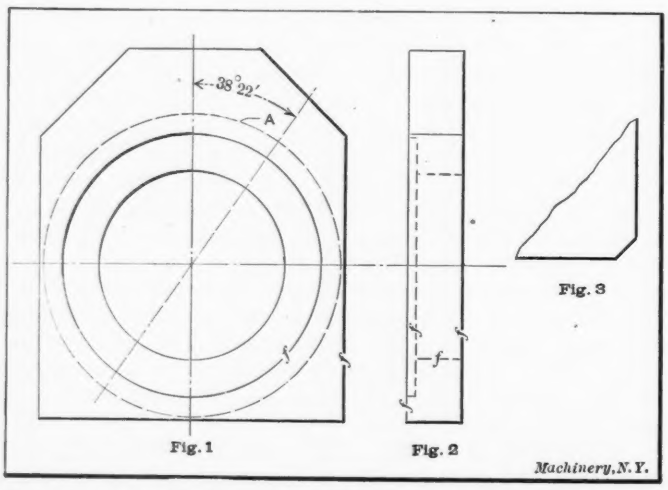
Jim got the angle-plates all planed, and then went back to the boring mill department to see what was next for him to do. He found that Mr. Anderson was nearly through. "Ready for some help?" he asked.

"Nearly," replied Anderson. "Have you got the angle-plates all planed?"

"Yes."

"See if you can find a sharp V-thread tool for me, no matter about the size as long as it has a sharp point."

Jim returned in a few minutes with a thread tool that he had ground to make sure that it was sharp. Mr. Anderson took it, and after stoning it to a smooth edge, put it in the tool pocket and brought it down onto the piece carefully, making a very light circular line on the top of the piece as large in



Figs. 1 and 2. Jig Baseplate and Desired Angular Setting of the Angle-plate. Fig. 3. Shape of Corner Recommended to avoid scratching Surface-plate

diameter as he could conveniently. (See broken line *A*, Fig. 1.)

"Now what did you do that for?" asked Jim.

"I shall use that line in laying out the angle to which the face of one of your angle-plates is to be set, as it is impossible to use a bevel protractor, and if I could it would not be as accurate as this way. You will see how it is done when we get to it."

"Couldn't you put it on with a pair of trams from a false center?"

"Yes, but false centers are rightly named—they generally *are* false—and I want that line to be as near right as possible. By putting it on in the machine, at the same setting that the hole is bored, I know that it is as near concentric with the hole as it can be gotten. Now we will get the piece on the truck and take it back to the toolroom. You get your scraper and I will get mine, as well as some files and squares, and then we will so some scraping.

"Now the first thing is to break all of the corners that are to be rounded over, that is, file them off like this." (See Fig. 3.)

"Why do we have to do that?"

"We will have to handle these pieces considerably and the sharp corners are disagreeable to the hands, and then on my piece there are several rough edges where the scale would come in contact with the surface-plate and would be likely to scratch it."

"But why not round them over now as long as it has to be done?"

"Because even though one is as careful as possible to clean all the dirt off the surface-plate before putting a piece on it, particles of dirt are liable to drop on the plate while rubbing the piece around on it, and a rounded corner is likely to draw these pieces of dirt in between the work and plate, which will scratch both, while an angle (as shown in Fig. 3) is more likely to push the particles along and keep the plate in better condition. In some shops it is the practice to file all corners off at an angle and not round them at all. I don't know but what it is just as good if not a little better, and it certainly takes less time.

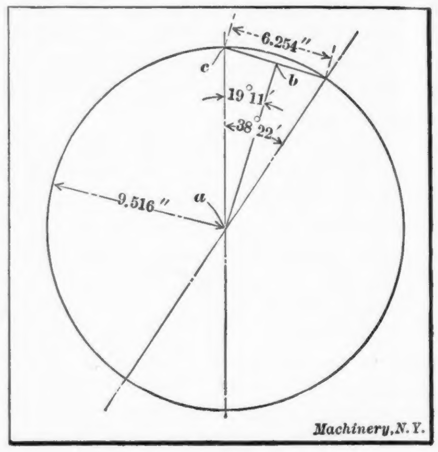


Fig. 4. Illustrating Method employed in laying out the Angle

"Now let us look your angle-plates over. This one is to have the bushing in it. It seems to be quite square, but this edge is a little the better. We will put the angle-plate on the base so that the best edge is toward the finished edge of the base, as our measurements will be taken from there. This will be the face that is bolted to the base and none of the corners of this face should be broken. These two faces and this side of the angle-plate must be scraped and spotted down so that they are perfectly square; the rest of the surfaces need only be scraped enough to smooth off the tool marks, and need not be spotted or squared. On this narrow angle-plate that is to locate the lugs of the cylinder, only the two outside faces need to be scraped up perfect and the rest of the surfaces need only be smoothed. The short end goes next to the base, so don't break any corners on it."

Mr. Anderson and Jim had just about finished scraping up the pieces when a helper came up with a cylinder on a truck and said, "The boss told me to bring this up here to you."

"Ah," said Mr. Anderson, "that is the piece that we are making this jig for. You see, Jim, these lugs are planed on a radial line through the center of the cylinder, and here where this boss is, a hole is required 38 degrees 22 minutes from the lugs, and 3 1/2 inches from the end of the cylinder. On the drawing the face of the lugs comes to the center line, but on the jig we will place *our* center line parallel to the edge that is finished, and set the cylinder on the jig so that the required hole comes on the center line of the jig. To put our center line on we will set the jig up on its finished edge and measure the distance from the edge of the hole down to the surface-plate. There are several ways of doing this, but we will use an indicator attached to a surface gage and an adjustable parallel; when we have the parallel adjusted so that when set upon the plate it is the same height as the lower edge of the hole, and have proved the same with the indicator, we have only to measure the thickness of the parallel with a micrometer to get the distance from the edge of the hole to the plate; to this distance we add half of the diameter of the hole and thus get the height of the center of the hole through which our center line passes. To this height we will set the scriber of a height-gage and scribe the center line. The next thing to do is to lay out another line passing through

the center at an angle of 38 degrees 22 minutes from the center line. To do this, we first lay the jig down flat and find the diameter of the circle that I put on in the boring mill. We take a pair of trams and set one leg on each side of the circle where the center line intersects it; you hold the trams in position while I examine the points with a magnifying glass to make sure that they are properly located. There! Now we will transfer the trams onto a scale and see what they measure—19.032 inches. Now we want to find the chord of 38 degrees 22 minutes with radius 9.516 inches, which is half of the diameter of the circle.

To make it clear, we will construct a diagram. (See Fig. 4.) We bisect the angle which gives us a right angle triangle $a\ b\ c$, which has a hypotenuse $a\ c$, 9.516 inches in length, and an angle of 19 degrees 11 minutes. The sine of 19 degrees 11 minutes is 0.32859, which multiplied by 9.516 is 3.12686,

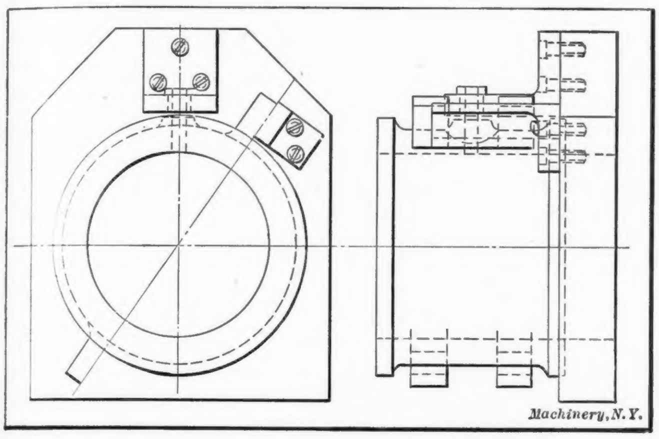


Fig. 5. The Completed Jig, and Work-piece in Place

and is equal to half of the required chord or $b\ c$. Multiply it by 2 and we have 6.25372, or 6.254 inches as the length of the chord.

"We set our trams to this distance, and with the point of one leg resting at the intersection of the circle at the top with the center line, we scribe a line crossing the circle at the right, and with the point of one leg resting at the intersection of the circle at the bottom with the center line, we scribe a line crossing the circle to the left. Now we have only to lay a straightedge across the piece with one edge of one end of it coinciding with the point where the chord intersects the circle, and the same edge at the outer end coinciding with the chord and circle at the opposite side of the circle. We will clamp it fast at each end and inspect it very carefully with a magnifying glass to see that it is in the proper position, and when it is we will take a scriber and scribe a line along the edge of the straightedge; this line will be 38 degrees 22 minutes from our center line.

"Now we can proceed to fasten on the narrow angle-plate. The long face comes just to the line; then when the cylinder is in the jig, and the lugs bearing against this angle-plate, it will be in such a position that the hole that is required will come in exact line with our center line, and now we have only to locate the angle-plate in which we place the bushing so that the center of the bushing comes parallel to the finished edge of the jig and the same distance from it as the center line, and of course have the bushing located in the angle-plate properly to get the hole the right distance from the end of the cylinder.

"Now you see why I wanted the circular line, and why I was so particular about having it accurate. We have used no bevel protractor, yet we have the angle more accurate than it would be possible to set a bevel protractor, to say nothing of the inconvenience, and practical impossibility of applying one in this case.

"The jig will be used on a horizontal boring mill, and to set it properly it is only necessary to place it on the table with the finished edge parallel to the boring-bar, and then line the bar up so that the drill enters the hole perfectly central."

The completed jig with the work-piece in place is shown in Fig. 5.

INTERNAL CUTTING TOOLS—2

PRACTICE FOR THE BROWN & SHARPE AUTOMATIC SCREW MACHINE

By DOUGLAS T. HAMILTON*

In the previous installment of this article, particular attention was given to drilling operations, feeds and speeds, drill holders and drilling attachments. In this article, which is a continuation of the same subject, internal cutting tools, the following subjects will be reviewed: counterbores and counterboring, feeds and speeds and holders for counterbores; reamers and reaming, feeds and speeds for reaming, and reamer holders.

Counterbores and Counterboring

As a rule, more trouble is experienced in applying counterbores to the work on automatic screw machines than any other cutting tool. This is probably due to the fact that they are generally improperly made for the work on which they are to operate. Generally speaking, there are several reasons for the unsuccessful working of counterbores, some of which may be summed up as follows:

1. Too many cutting edges, not allowing enough chip space and also not providing for sufficient lubrication.
2. Too much cutting surface in contact with the work.
3. Insufficient clearance on the periphery of the teeth.
4. Improper location of the cutting edges relative to the center.
5. Improper method of holding the counterbore.
6. Improper grinding of the cutting edges.
7. Having too weak a cross-section.
8. Using a feed and speed in excess of what the tool will stand.

For general work, and especially for automatic work where the counterbore cannot be withdrawn when it plugs up with chips and seizes in the work, it should not have more than three cutting teeth. The periphery of the teeth should be backed off eccentrically and also be tapering towards the back. The amount of taper generally given varies from 0.020 to 0.040 inch per foot. As previously explained, the relation of the cutting edge to the center also has an important bearing on

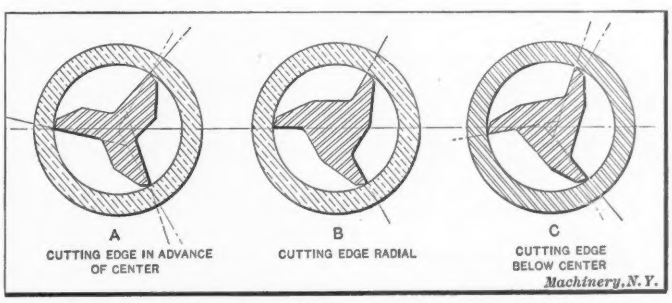


Fig. 11. Location of the Cutting Edges for Various Conditions

the efficiency of the tool. For deep counterboring where the difference between the diameter of the teat and the body of the counterbore is great, the cutting edge should never be located ahead of the center; in fact a little below the center would give far better results. This is only general, of course, as the material to a considerable extent governs the location of the cutting edges.

Location of the Cutting Edges

At A in Fig. 11 is shown a three-tooth counterbore with its cutting edges located ahead of the center. (These views are to be understood as looking on the front end.) Locating the cutting edge ahead of the center is advisable when the counterbore is to be used as a facing tool, or used for counterboring brass where it is not required to extend into the work to a depth greater than its diameter, but it should preferably be used for facing operations only. If the counterbore is made in this manner and used on steel, the cutting teeth have a tendency to force the chips against the surface of the work. Consequently when it is not properly lubricated, the work and counterbore become heated, and cause the chips to seize,

* Associate Editor of MACHINERY.

thus producing poor work and generally resulting in a broken counterbore.

At *B* are shown the teeth cut radially with the center. For general work this is the best location for the cutting edges relative to the center. It has not the same tendency of forcing the chips against the surface of the work and will not heat up as rapidly. Cutting the teeth radially with the center is suitable for either brass or steel work, but when used on steel it is preferable to have the teeth cut spirally. A spiral which will give a rake of from 10 to 15 degrees generally gives the best results.

At *C* are shown the teeth cut below the center. This is the proper location for the cutting edges of the teeth where the difference between the diameter of the teat and the body of the counterbore is not very great, and where the counterbore is to extend into the work to a depth greater than its diameter. This as can be seen, gives a lip to the counterbore which has a tendency to lift the chips from the cutting surface of the work, thus not allowing them to seize.

Various Types of Counterbores

When counterboring a hole where a large amount of material is to be removed, and where the counterbore is to extend into the work to a depth greater than its diameter, it is generally advisable to rough out the hole to the diameter of the body of the counterbore with a three-fluted drill, such as shown at *A*, Fig. 12. Then the counterbore is used only for squaring up the shoulder at the bottom of the hole. This method is especially advisable when counterboring machine or tool steel.

At *B* is shown a counterbore which can sometimes be used to advantage on brass work, but is not advisable for steel. It is made on the same principle as a flat drill with the exception that the teat has two cutting edges. At *C* is shown another counterbore for brass work, which has three cutting edges, and at *D* is shown a counterbore for steel work, having

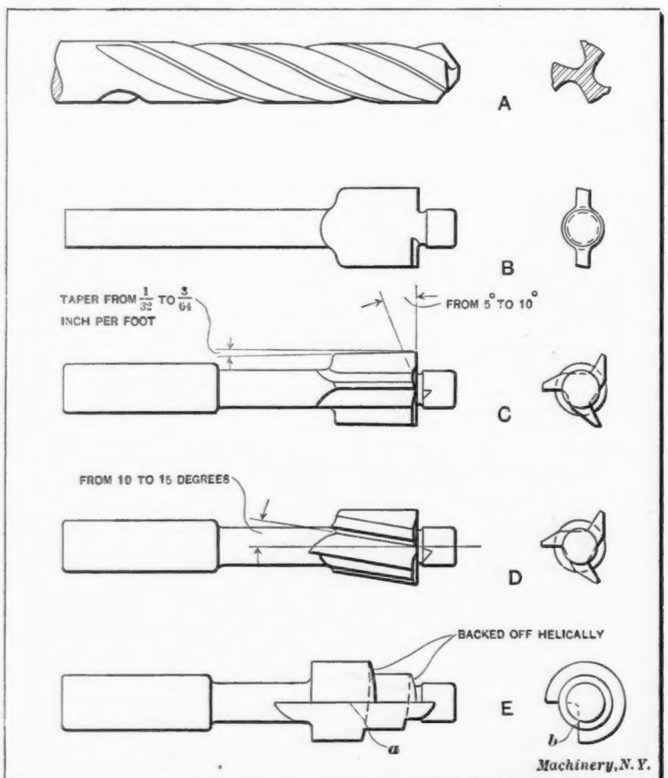


Fig. 12. Various Types of Counterbores

its teeth cut spirally. Having the teeth cut on a spiral which will produce a rake angle of from 10 to 15 degrees, is generally found suitable for machine or tool steel. Counterbores of the type shown at *C* and *D* should have inserted leaders or teats to facilitate their being re-sharpened.

At *E* is shown a counterbore which is recommended for work having complicated shapes, or requiring to have two or more diameters finished with the same tool. This tool is backed off helically as shown, thus allowing it to be ground and still retain its initial shape and size. The backing off is accomplished on the lathe in the following manner.

The lathe is geared up to cut six or eight threads per inch, depending on the diameter of the counterbore and the amount of clearance required. The counterbore after being turned to the required dimensions is milled as shown at *b*. It is then placed on the centers of the lathe, being driven by a dog and a facing tool used for backing it off. The backing off is accomplished by pulling on the belt for each cut, starting and finishing at the groove *b* until the backing off is completed. Where a backing-off attachment which is operated by a removable cam is available this tedious operation can be accomplished with

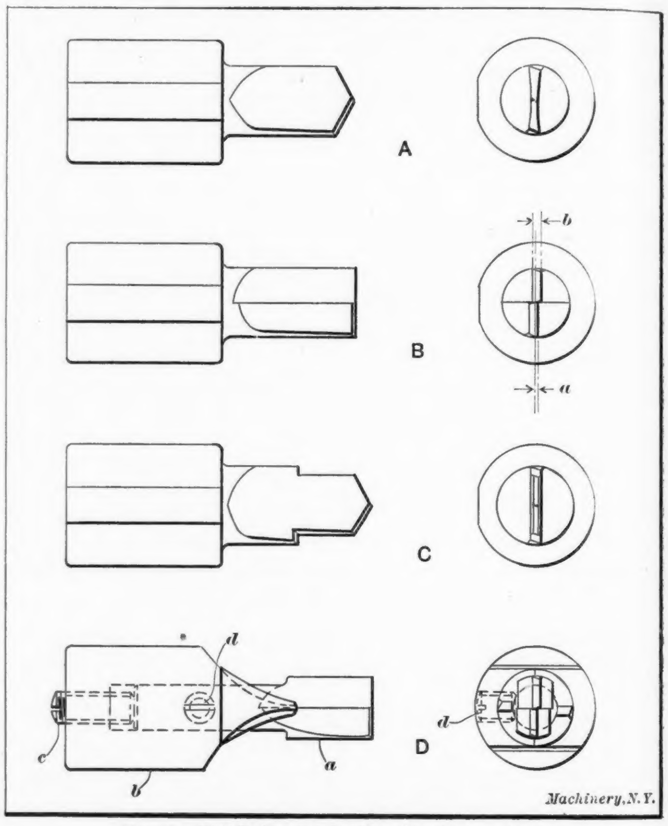


Fig. 13. Flat Drills and Combination Counterbores

greater ease and rapidity. The cutting edge *a* on a counterbore of this description should be radial with the center for cutting brass, but for cutting Norway iron, machine steel, etc., it should be cut spirally producing a rake angle on the cutting edge of from 10 to 15 degrees. The counterbores as previously described were for making pieces where the hole extended through the work or to a depth which admitted using a leader or teat; but for work where the hole bottoms, that is, does not extend far enough into or through the work, these counterbores could not be used. The ordinary method used in producing holes which bottom is to use flat drills and combination counterbores and facing tools.

Flat and Combination Counterbores

At *A* in Fig. 13, is shown a flat drill which is used for roughing out a hole having one diameter, and at *B* is shown the counterbore or facing tool which is used for squaring it up. The cutting edge *a* on the tool should be set about 0.10 inch times the diameter ahead of the center, and the thickness of the blade *b* should be about 1/8 of the diameter. At *C* is shown a flat drill or counterbore which is to produce a hole having two diameters, and at *D* is shown the combination counterbore and facing tool for squaring it up. This counterbore is made adjustable, the part *a* being adjusted out from part *b* by means of the headless screw *c*, thus governing the distance between the shoulders, the headless screw *d* being used to prevent the part *a* from rotating. When the part *a* projects out from the part *b* to a distance greater than one-half its diameter, care should be taken to have the shank a good fit in the part *b*. These counterbores can be used for either brass or steel work, but for steel work it is preferable to use a spiral drill for roughing out the hole, instead of a flat drill, as the material can be removed with greater ease and rapidity.

Speeds for Counterbores

The surface speed at which a counterbore can be worked is slightly less than the surface speed used for drilling. The surface speeds given below are recommended for counterbores made from carbon and high-speed steel.

SPEEDS FOR COUNTERBORES MADE FROM CARBON STEEL

Material	Surface speed in feet per minute
Brass (ordinary quality)	150-160
Gun screw iron	50-60
Norway iron and machine steel	40-50
Drill rod and tool steel	30-35

SPEEDS FOR COUNTERBORES MADE FROM HIGH-SPEED STEEL

Material	Surface speed in feet per minute
Brass (ordinary quality)	180-200
Gun screw iron	80-90
Norway iron and machine steel	70-80
Drill rod and tool steel	45-50

Feeds for Counterbores

The method of holding a counterbore when applying it to the work, and the strength of the cross-section in proportion to the width of the chip being removed, governs to a considerable extent the amount of feed to be given. The material being cut, and the depth to which the counterbore penetrates into the work, also has an important bearing on the rate of feed. These conditions should be taken into consideration when using the feeds given in Table IV. These feeds are for counterbores having three cutting edges, but for counterbores having one cutting edge the feed should be decreased from 40 to 50 per cent, and for two cutting edges, should be decreased from 15 to 20 per cent. Of course, it is obvious that no definite rule can be laid down in regard to the exact feed to use, on account of the number of conditions which govern the rate of feed. The feeds given in Table IV should be used only when the counterbore penetrates from one-half to three-quarters its diameter into the work. When the counterbore penetrates to a greater distance the feed should be decreased from 15 to 25 per cent. It is good practice to always drop the counterbore back after it has penetrated to a depth equal to half its diameter, to remove the chips, and to cool and lubricate it. The same method can be used for dropping back the counterbore as was given for deep-hole drilling in the preceding installment of this article.

TABLE IV. FEEDS FOR COUNTERBORES MADE FROM HIGH-SPEED AND CARBON STEEL

1/32-inch Chip			
Diameter of Counterbore in Inches	Brass Rod, Feed per Revolution	Mach. Steel, Feed per Revolution	Tool Steel, Feed per Revolution
1/8	0.0025	0.0018	0.0015
3/16	0.0030	0.0023	0.0020
1/4	0.0035	0.0030	0.0025
5/16	0.0045	0.0040	0.0030
3/8	0.0050	0.0045	0.0035
7/16	0.0060	0.0050	0.0038
1/2	0.0075	0.0052	0.0040

3/32-inch Chip			
Diameter of Counterbore in Inches	Brass Rod, Feed per Revolution	Mach. Steel, Feed per Revolution	Tool Steel, Feed per Revolution
3/8	0.0040	0.0032	0.0020
7/16	0.0045	0.0035	0.0025
1/2	0.0050	0.0040	0.0030
9/16	0.0055	0.0045	0.0035
5/8	0.0060	0.0050	0.0040
11/16	0.0070	0.0055	0.0045
7/8	0.0075	0.0060	0.0050

3/16-inch Chip			
Diameter of Counterbore in Inches	Brass Rod, Feed per Revolution	Mach. Steel, Feed per Revolution	Tool Steel, Feed per Revolution
9/16	0.0045	0.0035	0.0025
5/8	0.0048	0.0038	0.0028
11/16	0.0050	0.0040	0.0030
3/4	0.0055	0.0043	0.0032
13/16	0.0060	0.0045	0.0035
7/8	0.0065	0.0048	0.0038
15/16	0.0070	0.0050	0.0040

1/16-inch Chip			
Diameter of Counterbore in Inches	Brass Rod, Feed per Revolution	Mach. Steel, Feed per Revolution	Tool Steel, Feed per Revolution
1/4	0 0030	0.0028	0.0020
5/16	0.0035	0.0030	0.0025
3/8	0.0040	0.0035	0.0028
7/16	0.0045	0.0038	0.0030
1/2	0.0050	0.0040	0.0035
9/16	0.0055	0.0045	0.0038
5/8	0.0060	0.0050	0.0040

1/8-inch Chip			
Diameter of Counterbore in Inches	Brass Rod, Feed per Revolution	Mach. Steel, Feed per Revolution	Tool Steel, Feed per Revolution
1/2	0.0050	0.0042	0.0025
9/16	0.0052	0.0045	0.0030
5/8	0.0055	0.0048	0.0032
11/16	0.0058	0.0050	0.0035
3/4	0.0060	0.0055	0.0040
13/16	0.0065	0.0058	0.0045
7/8	0.0070	0.0060	0.0050

1/4-inch Chip			
Diameter of Counterbore in Inches	Brass Rod, Feed per Revolution	Mach. Steel, Feed per Revolution	Tool Steel, Feed per Revolution
11/16	0.0040	0.0030	0.0020
3/4	0.0042	0.0032	0.0022
13/16	0.0045	0.0035	0.0025
7/8	0.0048	0.0038	0.0030
15/16	0.0050	0.0040	0.0032
1	0.0050	0.0045	0.0035
......	......	......	......

Holders for Counterbores

For counterbores having leaders, a rigid holder should not be used, as the leader will follow the hole previously drilled or reamed, and if the counterbore is not allowed to float, it will produce poor work and sometimes result in a broken tool. At *A* in Fig. 14, is shown a floating holder which will be found very serviceable for the conditions just mentioned. The sleeve or shank *a* is made to fit the turret and is bored out from 1/32 to 1/16 inch larger in diameter than the shank of the holder *b*. The holder *b* is kept from turning by the driving pin *c*, which is made a driving fit in the part *b* and a loose fit in the part *a*. The hole in the part *a* should be about 1/32 inch in diameter larger than the pin *c*. The two headless screws *d* are used for adjusting the counterbore so that it will enter easily into the drilled hole. They also help to keep the holder *b* from turning. It is good practice, where possible, to chamfer the hole so that the leader will enter easily. The counterbore is held by the split bushing *e* and set-screw *f*.

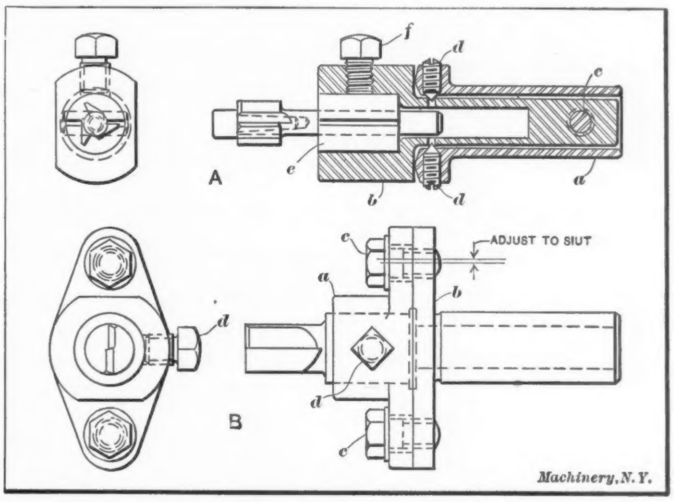


Fig. 14. Method of Holding Counterbores for Various Conditions

If this holder is properly made and set it will be found to give good results for general work.

At *B* in Fig. 14 is shown a "floating" holder for holding the flat counterbore shown. This holder in reality is not a floating holder, but would be better named an adjustable holder. It is made adjustable so that the tool can be set concentric with the center of the work. After adjusting, the part *a* is held tightly against the part *b* by the cap-screws *c*. The clearance holes in the part *a* for the cap-screws *c* are made about 1/16 inch in diameter larger than the body of the screw. The counterbore is held in the part *a* by set-screw *d*. This holder is also found very serviceable for holding a counterbore when the hole to be counterbored penetrates into the work to a distance greater than its diameter and a chucking drill has been used to rough it out.

Reaming and Reamers

When it is necessary to make a perfectly round and accurate hole in the work a reamer is used, the drilled hole being left slightly smaller to allow enough material for the reamer to true it up and bring it to the desired size. It is always advisable not to leave any more material to be removed by the reamer than is absolutely necessary. For general work the amounts given in the following list will give good results for reamers ranging in diameter from 1/8 to 3/8 inch. For reamers over 3/8 inch diameter, a drill 1/64 inch

less in diameter is generally used, and this would leave from 0.012 to 0.015 inch to remove on the diameter, as it is obvious that a drill will cut slightly larger than its nominal size.

Diameter of reamer in inches	Diameter of hole previous to reaming, in inches
1/8	0.120
3/16	0.182
1/4	0.242
5/16	0.302
3/8	0.368

There are various reasons for the inefficient working of a reamer, some of which are the following:

1. Chattering, which results when the teeth are evenly spaced or of an equal number.

2. Chips clinging to the teeth, which action results when high periphery velocities are used and insufficient clearance given.

3. Expanding and contracting of the hole which is caused

TABLE V. FEEDS FOR REAMERS MADE FROM HIGH-SPEED AND CARBON STEEL

Diameter of Reamer in Inches	Brass Rod, Feed per Revolution	Machine Steel, Feed per Revolution	Tool Steel, Feed per Revolution
1/8	0.007	0.004	0.002
3/16	0.008	0.004	0.003
1/4	0.009	0.005	0.004
5/16	0.010	0.006	0.005
3/8	0.011	0.007	0.006
7/16	0.012	0.008	0.007
1/2	0.013	0.009	0.008
9/16	0.014	0.010	0.009
5/8	0.015	0.011	0.010
11/16	0.016	0.012	0.011
3/4	0.017	0.013	0.011
13/16	0.018	0.014	0.012
7/8	0.020	0.015	0.012

by too great a feed and insufficient clearance on the cutting edges.

4. Enlarged and tapered hole due to holding the reamer rigid instead of floating.

There are various methods adopted to prevent reamers from chattering, but the unequal spacing of the teeth has been found the most satisfactory and inexpensive. The effects produced by unequal spacing of the teeth were clearly explained in MACHINERY, May, 1910. For machine reamers varying from 1/8 to 1/4 inch three cutting edges are sometimes used, but the difficulty encountered in measuring prohibits their use to a certain extent. As a general rule four and six cutting edges are used on reamers varying from 1/8 inch to 3/8 inch, and 8 to 12 cutting edges on reamers varying from 3/8 inch to 7/8 inch. When reamers are cut with an equal number of teeth the cutting edges are generally spaced unevenly. A practical table illustrating an efficient method of irregularly spacing the cutting edges of reamers was given in MACHINERY, January, 1906.

Chips clinging to the teeth is generally due to high periphery velocities and improper lubrication, the clearance given to the cutting edges also heating the work to a considerable extent, which causes the chips to cling. The clinging of the chips is more noticeable on steel containing a small percentage of carbon than it is on brass or steels which contain a high percentage of carbon.

Reamers are generally made slightly tapering towards the back; a taper varying from 0.002 to 0.005 inch per foot is generally used and a less taper should be used for brass than steel, as brass work, especially thin tubing, contracts and expands more readily than steel, so if a perfect hole is desired the reamer should be tapered very slightly. For reaming machine steel a rose reamer is generally used, as it has been found satisfactory for producing straight and perfect holes. This reamer is made tapering towards the back and is not relieved on the periphery of the cutting edges, the end of the reamer only being backed off.

The cutting edges of reamers are generally cut on the center for steel, but for brass work they are sometimes cut slightly ahead of the center, which produces a scraping action, and makes a smooth cut.

Reaming Feeds and Speeds

The surface speeds used for reaming should be slightly less than those used for counterboring, as the reamer generally penetrates to a greater depth and has more cutting surface in contact with the work, which tends to produce excessive heating of the work and reamer, resulting in chips clinging to the cutting edges. As is known, chips clinging to the cutting edges produces rough and inaccurate work. For general conditions and where a good supply of lard oil is used, the following surface speeds will be found satisfactory.

SPEEDS FOR REAMERS MADE FROM CARBON STEEL

Material	Surface speed in feet per minute
Brass (ordinary quality)	120-125
Gun screw iron	35-40
Norway iron and machine steel	30-35
Drill rod and tool steel	20-25

SPEEDS FOR REAMERS MADE FROM HIGH-SPEED STEEL

Material	Surface speed in feet per minute
Brass (ordinary quality)	150-160
Gun screw iron	65-75
Norway iron and machine steel	50-60
Drill rod and tool steel	30-40

The feeds for reamers given in Table V will be found suitable for general work, when no more material is removed on the diameter than previously given. When reaming thin tubing, especially brass, the feed should be decreased somewhat as excessive cutting pressure tends to produce an imperfect hole.

Holders for Reamers

The method used in holding a reamer when applying it to the work governs to a considerable extent the quality of the hole produced. When reaming a deep hole, if the reamer is held rigidly, it will nearly always produce a hole which will be tapered and larger in diameter than the required size.

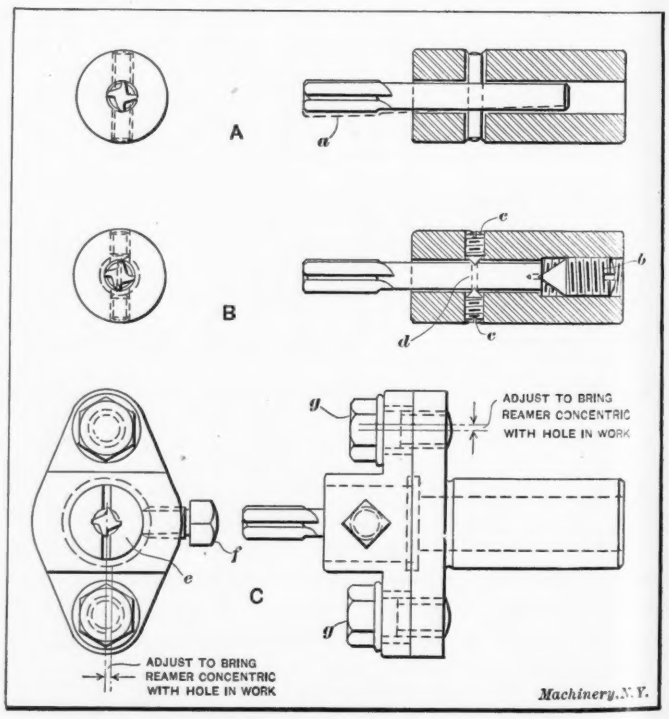


Fig. 15. Method of Holding Reamers for Various Conditions

At *A* in Fig. 15 is shown a floating holder which is sometimes used. This holder is cheaply made, but is not a commendable holder for automatic screw machine work, but can sometimes be used to advantage on the hand screw machine. One of the disadvantages of this reamer holder, is that the reamer drops down as shown at *a* if much clearance is allowed between the diameter of the reamer shank and the diameter of the hole, thus preventing the reamer from entering easily into the work, which generally results in a broken reamer.

At *B* is shown a more efficient holder, especially for deep hole reaming. The reamer is guided at the rear by a cone pointed screw *b* and is kept from rotating and guided at the same time by the two cone pointed screws *c*. By means of these screws the reamer can be set so that it will enter

the drilled hole easily, and at the same time be allowed to adjust itself to correspond to the eccentricity of the hole in the work. The small hole *d* is drilled through the shank of the reamer allowing the cone pointed screws to prevent it from rotating. This holder will be found very satisfactory for holding reamers when it is not necessary to remove an excessive amount of material. At *C* is shown a floating holder which is used for reaming shallow holes. The reamer is held rigidly by a split bushing *e* and set screw *f*. The reamer is set concentric with the hole in the work by loosening the cap-screws *g* and then locating it in the hole by the bevel or radius on the end. It is always advisable to do this when the spindle is not running, as otherwise the reamer may jump into the work and snap off.

* * *

MACHINE SHOP PRACTICE*

LOCATING WORK BY THE BUTTON METHOD

Among the different methods employed by toolmakers for accurately locating work such as jigs, etc., on the faceplate of a lathe, the one most commonly used is known as the button method. This scheme is so named because cylindrical bushings or buttons are attached to the work in positions corresponding to the holes to be bored, after which they are used in locating the work. These buttons, which are ordinarily about ½ inch in diameter, are ground and lapped to the same size and the ends squared. The diameter should, preferably, be such that the radius can be determined easily, and the hole through the center should be about 1/8 inch larger than the retaining screw, so that the button can be shifted.

As an illustration of the practical application of the button method, we shall consider, briefly, the way the holes would be

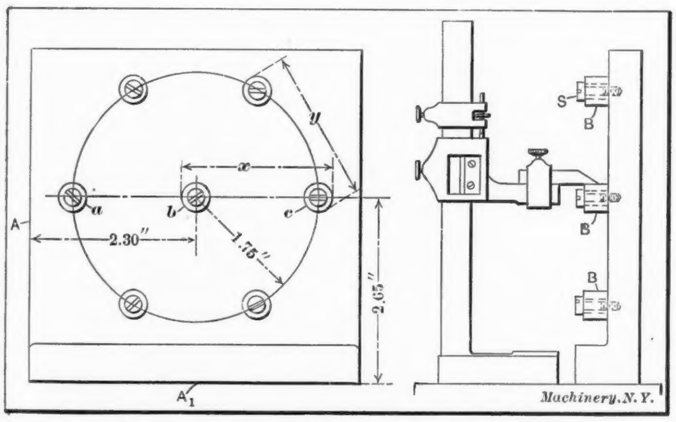


Fig. 1. Jig-plate with Buttons attached, ready for Boring

accurately machined in the jig-plate in Fig. 1. First the centers of the seven holes should be laid off approximately correct by the usual methods, after which small holes should be drilled and tapped for the clamping screws *S*. After the buttons *B* are clamped lightly in place, they are all set in correct relation with each other and with the jig-plate. The proper location of the buttons is very important as their positions largely determine the accuracy of the work. A definite method of procedure that would be applicable in all cases cannot, of course, be given, as the nature of the work as well as the tools available make it necessary to employ different methods. In this particular case, the three buttons *a*, *b* and *c* should be set first, beginning with the one in the center. As this central hole must be 2.30 and 2.65 inches from the finished sides *A* and A_1, respectively, the work is first placed on a surface-plate as shown; by resting it first on one of these sides and then on the other, and measuring with a vernier height gage, the central button can be accurately set. The buttons *a* and *c* are also set to the correct height from side A_1 by using the height gage, and in proper relation to the central button by using a micrometer or a vernier caliper and measuring the over-all dimension *x*. When measuring in this way, the diameter of one button would be deducted to obtain the correct center distance. After buttons *a*, *b* and *c* are set equi-distant from side A_1 and in proper relation to each other, the remaining buttons should be set radially from the central button *b* and the right distance apart. By having two micrometers or gages, one set for the radial dimension *x* and the other for the chordal distance *y*, the work may be done in a comparatively short time.

After the buttons have been tightened, all measurements should be carefully checked; the work is then mounted on the faceplate of the lathe, and one of the buttons, say *b*, is set true by the use of a test indicator as shown in Fig. 2. When the end of this indicator is brought into contact with the revolving button, the vibration of the pointer *I* shows how much the work runs out of true. When this pointer remains practically stationary, thus showing that the button runs true, the latter should be removed so that the hole can be drilled,

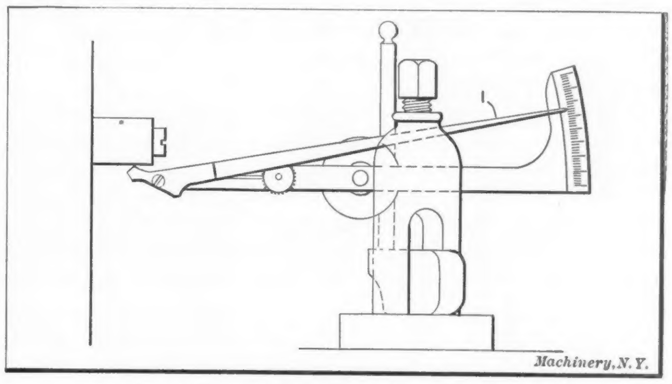


Fig. 2. Setting a Button True with a Test Indicator

bored and reamed to the required size. In a similar manner the other buttons are indicated and the holes bored, one at a time. It is evident that if each button is correctly located and set perfectly true in the lathe, the various holes will be to the required dimensions within close limits.

When doing precision work of this kind, the degree of accuracy will depend upon the instruments used, the judgment and skill of the workman and the care exercised. A good general rule to follow when locating bushings or buttons, is to use the method which is the most direct and which requires the least number of measurements. As an illustration of how errors may accumulate, let us assume that seven holes are to be bored in the jig-plate shown in Fig. 3, so that they are the same distance from each other and in a straight line. The buttons may be brought into alignment by the use of a straight-edge, and to simplify matters, it will be taken for granted that they have been ground and lapped to the same size. If the diameter of the buttons is first determined by measuring with a micrometer, and then this diameter is deducted from the center distance *x*, the difference will be the distance *y* between adjacent buttons. Now if a temporary wire gage is made to length *y*, all the buttons can be set practically the same distance apart, the error between any two adjacent ones being very slight. If, however, the total length *z* over the end

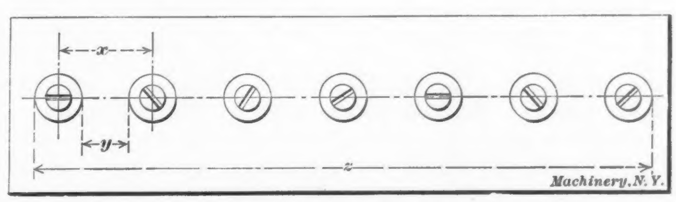


Fig. 3. Example of Work illustrating Accumulation of Errors

buttons is measured by some accurate means, the chances are that this distance will not equal six times dimension *x* plus the diameter of one button, as it should, as even a very slight error in the gage would gradually accumulate as each button was set. If, in this case, a micrometer were available that would span two of the buttons, the measurements could be taken direct and greater accuracy would doubtless be obtained. On work of this kind where there are a number of holes that need to have accurate over-all dimensions, the long measurements should first be taken when setting the buttons, providing, of course, there are proper facilities for so doing, and then the short ones. For example, the end buttons in this case should first be set, then the central one and finally those for the sub-divisions.

* With Shop Operation Sheet Supplement.

TAPER TURNING ON THE BENCH LATHE

By WALTER GRIBBEN*

The modern way of placing the slide-rest directly on the bed of a bench lathe has many advantages over the old method of having a shoe between the slide-rest and bed, especially when it is desired to do taper turning with the cross-slide, as is sometimes necessary. Those who have the old-style slide-rests can easily fix them so they will do all the "stunts" that the more modern designs are capable of by simply making a flat cast-iron washer of the same thickness as the shoe, and of a diameter not greater tnan the width of the shoe, the hole in the washer being a duplicate of that in the shoe, through which passes the holding-down bolt. By substituting this washer for the shoe as an occasional job demands, the cross-slide may be clamped at any angle with the bed that the work in hand calls for.

The job that was instrumental in making this washer an accomplished fact is shown in Fig. 1. This is made of ½ inch round Bessemer steel, and about 100 pieces were wanted. The point was to be turned to an angle of 60 degrees and the part *a* was to be just cleaned up with the turning tool, but was to be true with the point. The total length of the piece need not be very accurate. No screw machine was available for this job, so it was decided to cut off the stock with the power hack-saw and then do the turning in the bench lathe.

With the slide-rest as originally fitted up by the makers these pieces would have to be chucked twice; the slide-rest set first to turn the parallel part on all the pieces, and later set to turn the conical point; and each piece chucked a second time for this operation. If this had been done there would have been considerable uncertainty about the truth of the work when finished. Bessemer rod is not always exactly round, and the lathe was old and had been abused. It would have been extremely difficult to chuck these pieces a second time and have the part that was turned at the first chucking run true, so that scheme was abandoned as not even worth trying.

Another way that might have been used is to set the top slide around for each piece, turning the parallel part of the first piece and then setting the top slide around for the cone of that piece. When the second piece was chucked the cone might be turned first and the slide-rest afterward set for the parallel part. For the third piece the parallel part might be turned first, and so on. This would have been a very slow way, and the 60-degree parts might have varied somewhat among themselves as to the proper angle.

The way these pieces were actually made is shown in Fig. 2. A washer was made, as previously described, and put in place of the shoe under the slide-rest, so as to enable the cross-slide to be set at any desired angle. The top slide was first swiveled around 60 degrees from its usual position and clamped fast to the lower or cross-slide, after which the entire slide-rest was set around on the bed until the top slide would turn parallel when tried on a scrap piece. The pieces were then chucked and the parallel part turned by means of the upper slide, while the conical point was turned by means of the cross-slide, each piece requiring but one chucking, and the two parts being true with each other, according to specifications.

To Mr. A. E. Clark is due the credit of having first suggested and used this washer under the slide-rest. It is a very handy appliance when turning bevel gear blanks, especially if a number of one kind is to be turned at a time. Also it is very useful when making saw washers, which are much better if turned slightly dishing.

When the taper to be turned is almost flat, like the dished saw washer just mentioned, and an attempt is made to turn it by setting the top slide around, the cross-slide remaining on the regular shoe, the difficulty is encountered of having no good way to feed the tool in for depth of cut, as then the two slides are very nearly parallel, and if it is a job where the depth of cut is required to be measured by the micrometer disk on the feed-screw, the micrometer will not denote the true value of the depth of cut, but its indications will have to be multiplied by the sine of the angle included between the axis of the feed-screw and the surface of the work being turned. The plain round washer under the rest eliminates these objectionable features, as the two slides of the rest may then be left at right angles to one another, so that the feed-in for depth of cut is not only more easily accomplished, but the depth of cut can then be correctly measured, if desired, by the micrometer disk on the feed-screw.

In the case of a lathe having raised V's on the bed instead of a flat top, it is not necessary to put V grooves in the bottom of the washer, but it may be left flat on the bottom and rest directly on the flat part of the bed between the V's, as shown in Fig. 3. It should be cut away adjacent to the V's, as shown, so as not to touch them. The total thickness

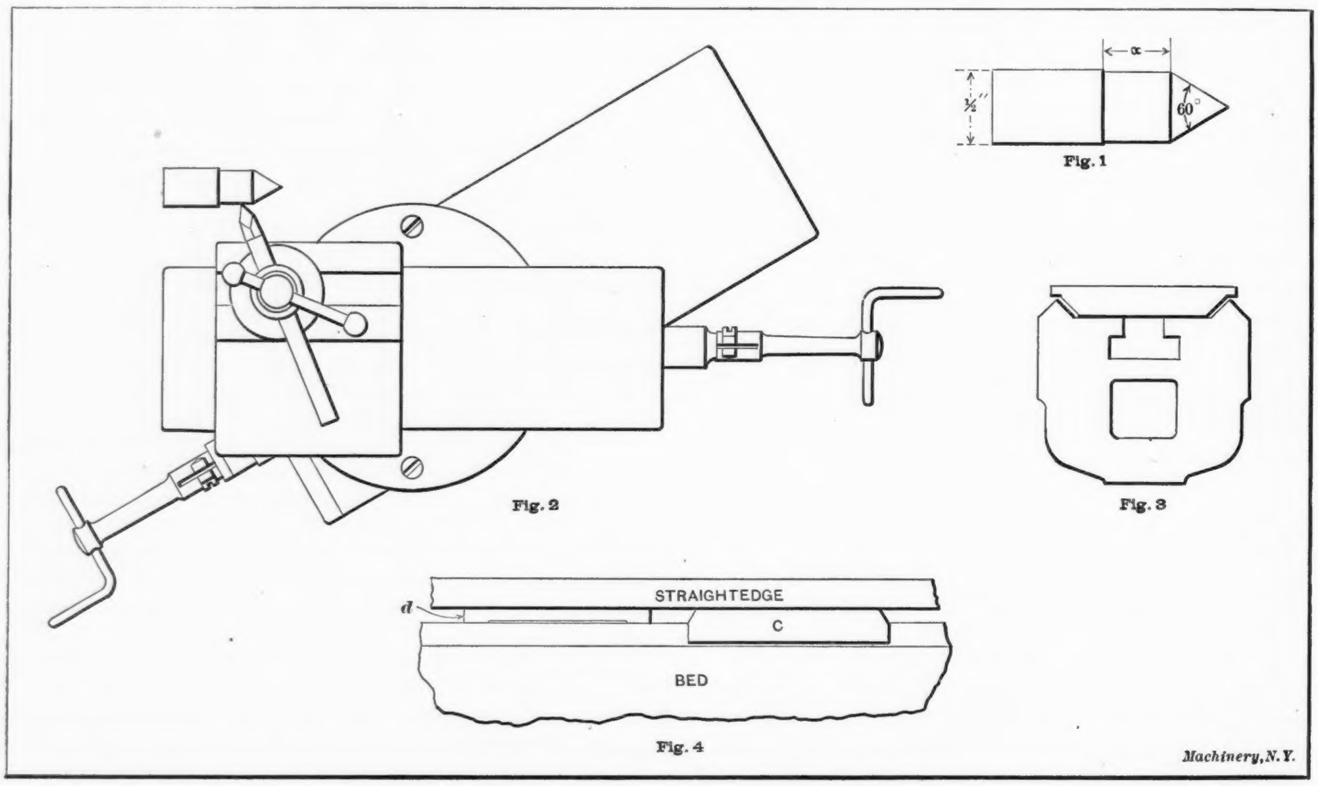


Fig. 1. Piece to be made. Fig. 2. Method used in making the Piece shown in Fig. 1. Fig. 3. Showing how Washer is placed under Slide-rest. Fig. 4. Showing how Washer is leveled up

* Address: 314 Halsey St., Brooklyn, N. Y.

of the washer in this case should be such that when placed on the bed beside the regular shoe, a straightedge laid across their tops should touch both, as shown in Fig. 4, which is a front elevation, *C* being the original shoe, while *d* is the round washer.

Fig. 2 shows the extension handles that are put on in place of the regular ball handles when the top slide is set around very much, so as to avoid interference. These extension handles are made of a composition casting for the shank, bored out to fit the end of the feed-screw, split and closed with a pinching screw, while the cross handle is made of Bessemer wire bent to shape and soft-soldered in. This makes a good enough job for a handle that will only be used at comparatively long intervals.

* * *

PERTINENT POINTS ON JIG AND FIXTURE DESIGN

By T. COVEY

I read with considerable interest the article on the above subject by Mr. C. Nosrac, in the August number of MACHINERY. In fact, I am always interested in articles of that nature, and being a mechanic myself, I have some ideas of my own on the subject. I do not agree with Mr. Nosrac's idea of a correct design for jig bushings, though I will say that they might be permissible for the very small sizes.

He states that "the length of a bushing should be sufficient to support the drill on each side regardless of the fluting," and in his diagram designates the length of the drill bearing to be equal to the lead of the spiral of the drill. The angle of spirals of drills varies from 18 degrees to 35 degrees. The Cleveland Twist Drill Co. has adopted, after exhaustive experiments, an angle of 27 1/2 degrees as the most satisfactory for all classes of work. This angle makes the spiral groove of all drills start at the point with a pitch equal to six diameters of the drill; hence, according to Mr. Nosrac's standard, a bushing for a one-inch drill should be six inches long.

He also states that "the lower end of the bushing should stop about the same distance above the work as the diameter of the drill." Now as I look at it, the object of clearance between the bushing and the work is to prevent the chips from wedging between the bushing and the work and thereby springing the jig or wedging the work fast, so that it is difficult to remove it from the jig. I think that 1/16 inch on the smaller sizes, varying to 3/16 inch on the larger sizes, is ample to overcome this difficulty. I know of some designers who advocate placing the bushing as close to the work as possible without interference and thereby force the chips up through the bushing, but I think that is a poor plan.

He says further that "the heads of the bushings should be large enough to prevent the operator from starting the drill on the outside of the bushing instead of on the inside." In my opinion, an operator that would do that should be classed with one that would run a drill through the drill press table, or the spindle of the lathe—such a person should be immediately discharged. The heads of the bushings should be made as small as is consistent, leaving sufficient shoulder to locate the bushing properly, and in the case of fixed bushings the shoulder may be dispensed with entirely, as a matter of economy in stock and manufacture. The radius at the entrance of the hole should never exceed 1/32 of an inch because a larger radius decreases the length of the bushing acting as a guide, and makes it difficult work to locate the drill over the hole when the jig is fixed to the drill table, or base, or is too large to float into position. The lower end of the bushing should have very little or no radius at all so as to prevent the chips from drawing in between the drill and the bushing.

Mr. Nosrac also shows the lower end of the bushing slightly tapered to drive easily thereby, suggesting that the bushing should be considerably larger than the hole in which it is placed. From one-quarter to one-half thousandth of an inch larger than the hole is ample; more than this is liable to decrease the size of the hole and make it necessary to lap it out again, or to place a strain on the jig and impair its accuracy. If the corner is rounded just enough to prevent shearing the hole, and the bushing driven reasonably carefully no difficulty will be encountered. In his diagram he shows a long bushing with the diameter of the hole increased at the top "to prevent the drill binding on account of excessive bearing." All standard makes of twist drills are made with longitudinal clearance, which is obtained by decreasing the diameter from the point to the shank varying from 0.0005 to 0.0015 per inch, thereby automatically obtaining the desired clearance. If relief from the excessive bearing was considered desirable, the place to put it, from a mechanical standpoint, would be in the center of the bushing thus giving the drill the benefit of a more rigid guiding.

* * *

CONE-BELT SHIFTER

By ALVIN C. RENNER*

In operating large lathes having cone drives and driven by wide belts which are drawn tight, it is a difficult task to shift the belt from one cone to the other. We had this trouble in our shops, so I thought out a scheme for shifting the belt with greater ease and rapidity.

On one of our 30-inch three-cone engine lathes driven by a 4-inch belt we had to shift the belt onto the largest cone to

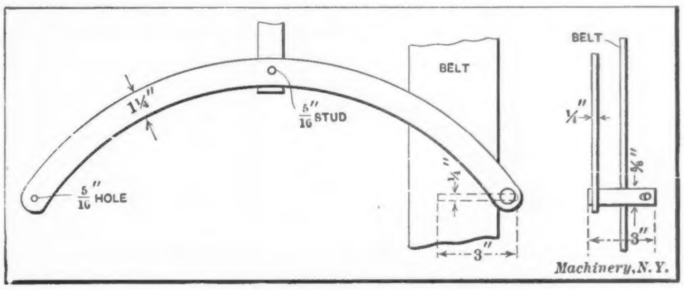


Fig. 1. Details of Cone-belt Shifter

get the desired cutting speed. When changing the speed from the larger to a smaller cone, the belt being drawn tight, made it difficult to shift. The belt could not be shifted by hand, so it was necessary for the operator to climb up on the lathe or use a long pole to shift it. To eliminate this difficult and slow operation, I devised the belt shifter shown in Fig. 2.

Taking a piece of 1¼ by ¼ inch flat machine steel 24 inches long and bending this to a circular shape, as shown in Fig. 1, I drilled a ⅝-inch hole in one end and then drove in a piece

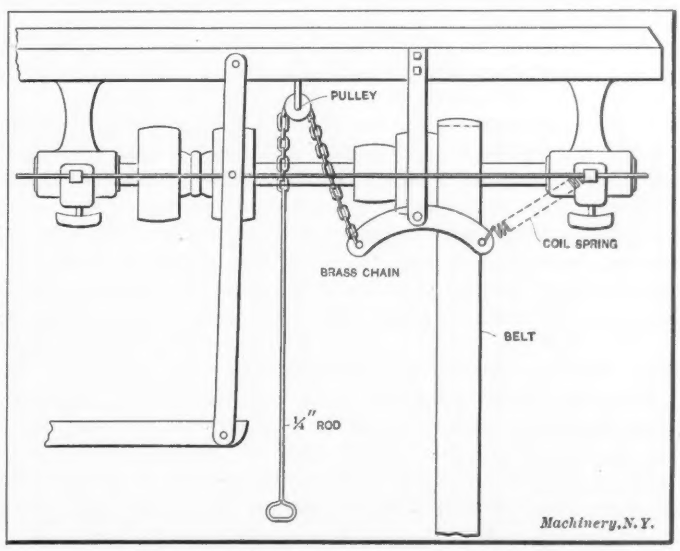


Fig. 2. View showing Cone-belt Shifter in Position

of machine steel about 3 inches long. Through one end of the ⅝-inch rod I inserted a piece of ¼-inch rod about 3 inches long, bending it slightly on the end, as shown. The circular strip was then attached to a piece of flat machine steel, cut to the required length, by a 5/16-inch stud. This strip was then fastened to the countershaft block with two lag-screws. The other details of the shifter are clearly shown in Fig. 2, and will not require further explanation.

* Address: Aurora, Ind.

LETTERS ON PRACTICAL SUBJECTS

We pay only for articles published exclusively in MACHINERY.

DIE WITH AUTOMATIC STOP FOR BLANKING WASHERS

The following description of an automatic stop which is used successfully in blanking washers, three at a time, may be of interest to some of the readers of MACHINERY. The die shown in Figs. 1 and 2 was made similar to an ordinary die, but was held to the die bolster by means of four fillister-head screws, and four dowel pins, instead of being held in a bolster which is grooved, and the die set into it. Holding the die in this manner obviated the necessity of planing an angle on the edge of the die, and also held the die satisfactorily. As the way the die is made and held is clearly shown in Figs. 1 and 2, it will not be necessary to give any further explanation regarding it, so we can turn our attention to the stop, which is the main feature of this design. The two brackets *A* are made of cast iron, and passing through them is a rod *C* to which the stop is attached by a split knuckle *D*, this knuckle being held to the rod *C* by means of the cap-screw *K*. Two washers *E* are fastened to each end of the rod on the outside of the brackets, to obviate any longitudinal movement, but allowing it to rotate easily in the bracket *A*. The stop can be adjusted through the knuckle *D* by means of the adjusting nuts *F*. The manner in which this stop operates is as follows:

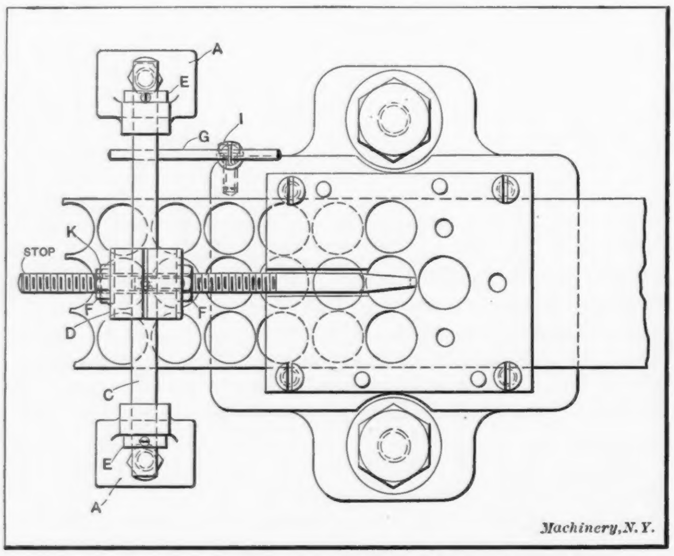


Fig. 1. Plan View showing how Three Washers are blanked with One Stroke of the Press

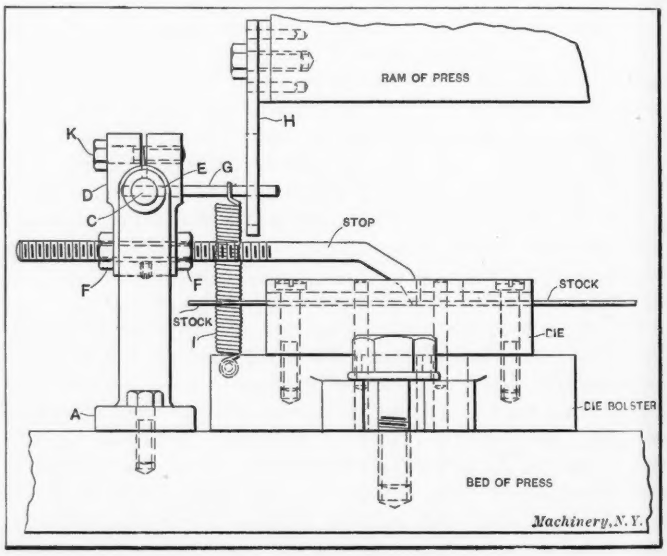


Fig. 2. Side Elevation showing how Automatic Stop is attached and operated

As the ram of the press ascends, the block *H* (Fig 2) which is fastened to the ram, as shown, and has a longitudinal slot in it, raises the pin *G*, which is driven through the rod *C*. As this pin is lifted it rotates the rod *C* and consequently raises the stop against the tension of spring *I*. When the stop is raised, the feed-rolls force the stock through the die, but the ratchet is so set that the stop drops before the stock has been fed the required distance. The feed used is the ordinary ratchet feed and is set so that it feeds 1/16 inch further than the required distance to compensate for any slip, such as often takes place in ratchet feeds which are used for punch and die work. By referring to Fig. 1 it can be seen that three washers are punched out with each stroke of the press, and as the press was operated successfully at 90 strokes per minute, it can be seen that this gave a large output in a day.

Philadelphia, Pa. CHARLES W. DORRICOTT

FOREMEN I HAVE WORKED FOR

A man who has worked in twenty-five states naturally meets a great many men of various types whose skill or experience has entitled them to a foremost position.

My first boss certainly had his troubles. There were about 16 boys ranging from fourteen to twenty years of age in the shop, and he had his work cut out for him to produce results. This he accomplished without being harsh with us. He just had the knack of getting along and also of helping others. I might say that at the present time George is superintendent of a large plant in the East, so I guess he still has the knack of getting along with the boys.

The remark of a lawyer in regard to the temper of one of the judges would just suit my next boss. He was the most even tempered man I ever saw. He was mad all the time. Whether the sun shone or it rained, he was always the same. It made no difference to him. We paid no attention to him and did as little as we possibly could to hold our jobs.

A man of ability could write a book on what happened at one place I worked in. It happened that the previous foreman —a man well-liked—had been discharged, and a Russian Jew replaced him. This man was hired just for the purpose of driving us, and being, in the language of the trade, "a bunch of boomers," we would not drive at all. We were all single—it was a small town which none of us liked—spring had arrived and most of us had worked from coast to coast and all were anxious to be on their way again. The only reason we did not strike was because we thought we could have more fun there than in any other place we knew of, and I think we succeeded. We slowed down our machines, did poor work, loafed half the time, and if a man was fired he cussed the foreman. The foreman had to take it because he knew if he resisted, he had to "lick" the gang. When one man was discharged the next man would be just as bad, so the foreman brought in a revolver with him one day and left it in his coat pocket over his desk, from which one of the men took it. The foreman asked one of the boys if he had seen anyone near his coat, that he had lost some valuable documents which he had in his coat. The boy told us, and the next day one of the men hung a glass revolver above his desk, with the sign "Valuable documents have been found." I never heard any more about this, as I left, and when I quit things were just as bad as ever.

Another foreman with whom I worked was the man who thought everything might come in handy some day. He had the floor and the benches piled up with scrap iron which was of no earthly use except to be in the way. If he found a horseshoe in the yard he brought it in saying that it might come in handy some day.

I think the meanest foreman a man could work for is the one who is incompetent and who makes lots of mistakes and gives wrong orders and then blames the man or men for the mistakes. I think most men have met this kind of a foreman, and if a person started a contest for the meanest man he would have first place. Friendship usually puts him in this position and the men have to suffer until the company wakes up.

I worked for one man who was stuck on his job and he was afraid he would lose it. He let us all know what a swell job he had and how many would like to have it. This kind of a man seldom has the best class of men working for him as he feels that in keeping a good man any length of time he will get his position, so he finds some means of dispensing with his services.

I might also mention the foreman who listens to tattling. The truth is that a man who tattles on his fellow workmen to the foreman usually tells on the foreman to the man higher up, so that the foreman who encourages tattling as a rule digs his own grave.

My experience has been that the best foreman for both men and company is the one who has a standard of work both in quality and quantity, insists on having a high standard and also insists, in return, that his men be well paid. This man has little to say during working hours except about business matters; he shows no partiality, never looks for trouble and keeps only the men who are good men in their particular line of work, and above all, is a competent man himself. With such a man the men and company are sure to be satisfied.

K. P. C.

A MOTOR CAR REPAIR JOB

Motor car repairing has brought us face to face with much that is novel and interesting, not to say a little perplexing, inasmuch as most of such work is double-tagged "rush," and expedients have to be employed that would be unnecessary if the work were allowed to take its regular turn. To the credit of machinists in general and for the benefit of car owners, who, by the way, are wont to discover that everything associated with the automobile has a special "high" price affixed to it, be it said that they take hold of such work with a zest that goes a long way toward a reasonable repair bill. All of which leads up to a job we did on the rear axle housings of a machine of the well-known Jackson make.

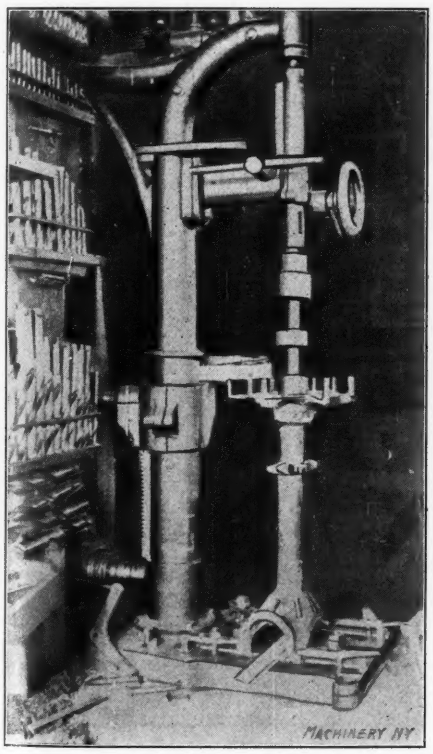


Fig. 1. How Rear Axle was set up to bore the Housing

During a winter's overhauling at a garage, the spiral roller bearings used on the axle had been removed and, in replacing, they had not been fastened in securely, thus permitting them to "work" until the housing was worn 1/16 inch on the top. It was proposed to bore it out and put in a sleeve that would obviate lost motion. Now this boring was really more formidable than its telling would imply, because of the brake and guard supports that were riveted to the housing as shown in Fig. 1. This construction dissipated any hope of getting a steadyrest within a foot of the end, so we turned to the drill press for assistance and, finding it easier than we expected, soon had a cut going.

Fig. 1 shows how the housings were clamped and bored. The rear axle was strapped lightly to the base of the drill press until it was brought directly under the spindle, and then fastened securely. At the end of the space occupied by the roller cage was a collar *R* (see Fig. 2), with a 1¼ inch hole which centered the boring-bar at the lower end and concentric with the original hole. A piece of 1¼ inch shafting was used as a boring-bar. To guide the upper end, a piece of cast iron *C* was bored, making it a sliding fit on the bar, and recessed to fit snugly over the end of the housing. Fig. 2 shows this cap *C* as well as the lower collar *R* in position for taking a cut when *C* is lowered into place.

To offset any lack of alignment in the machine, spindle and chuck, and also any error in setting, the boring-bar was made in sections. This "universal joint" consisted of a short piece of ¾ inch stock *D*, set in a 13/16 inch recess in the boring-bar *B* and connected by a ⅜ inch pin *P*. The ⅜ inch hole was slotted sideways to allow for a certain amount of lateral movement should that be necessary from any lack of alignment.

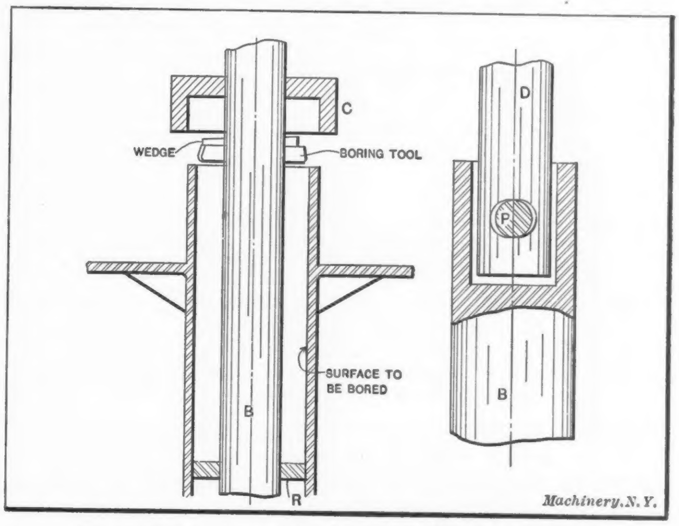


Fig. 2. Details of the Boring-bar and Method of Locating the Boring-bar in the Housing

Two cuts down the inside of the housing produced a perfectly round and straight hole. A piece of Shelby tubing machined inside and out was driven into the casing, which restored the rollers to their former position in contact with the axle. Before driving in for good, the usual diagonal slot was cut in the sleeve.

Donald A. Hampson

Middletown, N. Y.

AN EFFICIENT FIXTURE FOR DRILLING LEVERS

In no branch of machine design can the draftsman exercise more ingenuity than in the design of jigs and fixtures, and the closer his acquaintance with practical machine-tool processes, the more successful he will be.

It is not always easy to determine the difference between a fixture and a jig, and in many cases their functions seem to overlap so far, that they must be considered as combinations. Broadly considered, a fixture is attached to, and is worked in conjunction with, a regular machine tool, while a jig is a device for holding a part of a machine to be operated upon, but which is not attached to the machine tool. Both have for their object the cheapening of production and the securing of greater accuracy of product.

The apparatus herewith described could be termed a jig, because it holds a lever to be subjected to the operation of drilling, and it might also be described as a fixture, with propriety, because it is bolted to the table of a drill press.

The levers to be drilled are of such a shape that it would be hopeless to try to attain accuracy and speed without the employment of this fixture, and as similar shapes are often encountered in machine construction, a close study of the tool cannot be otherwise than profitable to those who have to produce results. The lever to be drilled, Fig. 1, consists of a long central hub *C*, from the ends of which the journals that form the fulcrums, project. These journals govern the positions of all the other machined parts upon them. The pressure screw *A* transfers its action to other parts of the machine by means of its semi-globular point, and therefore its position need only be approximately correct, but the end *B*, being linked to accurately machined parts of the machine, must have the

center line of its hole exactly parallel with the center line which passes through the journals. Any deviation from correctness would not only add greatly to the cost of assembling, but would also destroy the accurate and smooth action of this joint. The problem is therefore narrowed down to the drilling of two holes, one of which may be approximately parallel with the plane in which the center line of the journal lies,

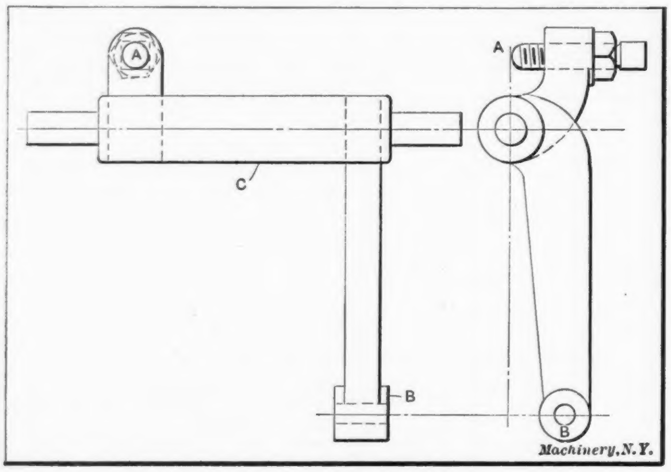


Fig. 1. Lever to be drilled

and the other of which must be parallel with the journal axis.

As the levers come to the drill press with the journals accurately machined, it is evident that this part of the lever is the proper point by which to support it. Necessarily the supports for the journals have to be parallel with the center line of the spindle of the drill press, and they have to be adjustable in that line in order to accommodate all the different sizes of levers. By the adoption of this simple and efficient fixture all the sizes may be drilled.

To accomplish this, a kneeplate *C* (Fig. 2) is provided whose base and vertical face are carefully machined at right angles with each other. The vertical limb of the kneeplate is made long enough to accommodate the largest of the levers, and is provided with a slot extending almost its entire length, for the accommodation of the supports for the journals. The supports consist of V-blocks whose sides subtend an angle of 90 degrees, and which are provided with projections entering into the vertical slot in the kneeplate, thus insuring at all times the parallelism of the V-blocks with the center line of the drill press spindle. A cap *D*, hinged to each V-block and fastened by a hinged bolt, secures the journals in the V-block and gives them the usual "three point" support as is shown in Figs. 2 and 3. As the levers project from the V-blocks from four to twelve inches, it is evident that a support *E*, shown in Fig. 3, has to be provided between the lever and the drill press table. This support must be adjustable by hand, and bear against the lever at three points around the hole to be drilled, so as to accommodate itself to any roughness or discrepancy in the lever casting.

The smallest lever has a ¼ inch hole through a ¾ inch boss and the largest lever has a hole 1¼ inch in diameter in a boss which measures 2¾ inches. As the hole in the support has to be slightly larger than the hole in the lever, so as to clear the drill, the hole in the largest support is made 1⅜ inch, and as the boss of the smallest lever is only ¾ of an inch, the largest support could not be used for the smallest lever, but one support is used for two sizes.

Figs. 2 and 3 show the construction of the supports. The foot *F* into which all the supports fit is a casting with a machined base, which sits loosely upon the drill-press table, its upper end being tapped for a 1 inch gas pipe. The supports *E* consist of pieces of gas pipe, fitting loosely into the foot so that they can be turned easily by hand. The upper end of the pipe is cut away so as to leave only four strips spaced at equal distances, which are bent to enclose the cast-iron cap *G* loosely. This cap is semi-spherical on the under-side, so that it may accommodate itself easily to the boss which is to be drilled. The flange around the edge of the spherical base which is enclosed by the bent strips of the pipe, serves to keep the pipe and cap together. The top surface of the cap is provided with three radial ribs which bear against the under surface of the boss on the lever.

A stand *H* is bolted to the table of the drill press, its upper end terminating in a boss into which hardened interchangeable guide bushings for the drills are inserted. These bushings are all of the same outside diameter with holes bored to correspond to the size of the drills used. There is a screw *L* under the guide bushing by which the location of the boss to be drilled can be regulated horizontally, so that all the holes will be drilled centrally in the boss. As no great accuracy is required in the location of the hole for the pressure screw in the opposite arm of the lever, the pattern is provided with a countersink where the hole is to be drilled, the latter operation being performed when the lever is taken out of the fixture.

A sample of each size of the levers is always kept on hand and when a lot of any particular size is to be drilled the proper sample is selected and by means of it the necessary adjustments of the fixture are made.

By means of the thumb-nuts *M* on the hinged bolts attached to the V-blocks the levers can be fastened into and taken out of the fixture without the use of a wrench. After the fixture has been properly adjusted and fastened to the table of the drill press by the foreman, an apprentice can turn out large quantities of very accurate work, and, at the same time, the breaking of drills is reduced to a minimum.

The lever shown in Fig. 1 is right-hand and the one fastened in the fixture, Figs. 2 and 3, is left-hand. The fixture is so

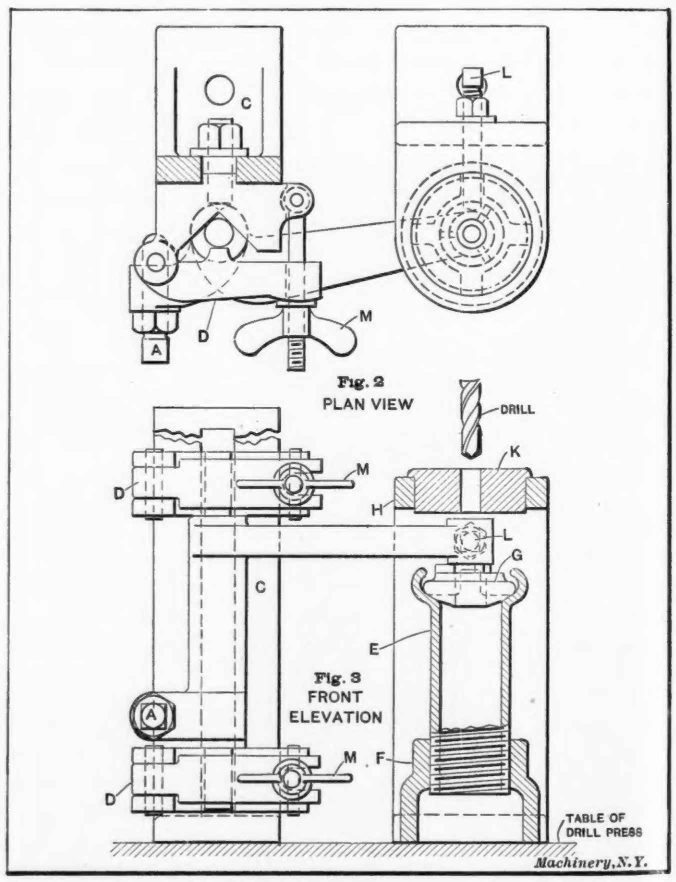


Fig. 2. Plan View of Fixture used in Drilling the Lever shown in Fig. 1. Fig. 3. Front Elevation of Drilling Fixture showing Method of Supporting the Levers

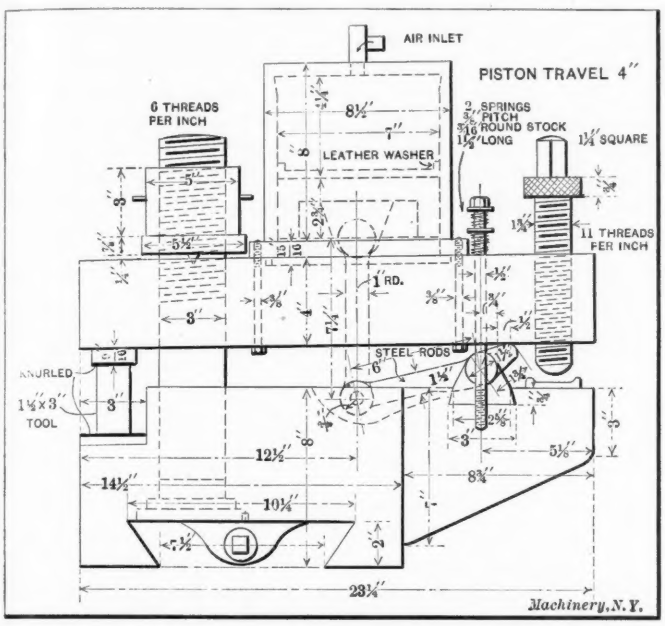
arranged that it will take both right- and left-hand levers. When left-hand levers are to be drilled, the kneeplate is fastened to the left of the drill press spindle, and when right-hand levers are drilled it is fastened on the right side.

When it is considered that there are twelve different sizes of levers and a right- and a left-one of each size, or twenty-four different pieces in all, and that a single fixture with twelve guide bushings and six pipe supports is all which is required to produce accurate work in large quantities, and by the cheapest kind of labor, the design of this fixture must rank as a very successful achievement. CHARLES C. KLEIN

Fox Chase, Philadelphia.

PNEUMATIC TOOLHOLDER FOR TIRE TURNING

With the advent of high-speed steel tools and powerful lathes for turning car wheels, the changing of the tools for each tire and each cut became a laborious and also a very difficult operation. When we consider that the tools have to be changed three times for each tire, and that it takes a short time to complete the turning operation, it is obvious that the amount of time and energy required to change and clamp the tools is enormous. To obviate this laborious and difficult work of clamping, the pneumatic toolholder shown in the accompanying illustration was designed. The pneumatic toolholder shown was used on a John Bertram 36-inch car-and-truck-wheel lathe. Forty pounds air pressure is carried



Pneumatic Toolholder used on John Bertram Car-and-truck-wheel Lathe

throughout the shop and this, in connection with the leverages in the toolholder, was found sufficient to hold the tools rigidly. Selected brands of 3 by 1 1/2 inch high-speed steel tools were used and a surface speed of 17 feet per minute for rough turning, with a cut 1/2 inch deep, and 1/2 inch feed per revolution. Formerly it was necessary to have two men on one lathe. Now it is possible for one man to operate the machine, as the necessary setting and clamping of the tools may be accomplished with ease and almost instantaneously. This holder has been successfully used for six months and has been found so efficient that all the tire lathes have been equipped with similar devices.

Canadian Pacific Railway Apprentice

CONVERTING A SIX-INCH VERNIER INTO A HEIGHT GAGE

Anyone having a six-inch vernier can, at small expense, convert it into a height gage, by making the additional parts shown in Fig. 1.

The outer jaw of the vernier must be ground square with the outer edge of the scale. The slot in the base is then cut

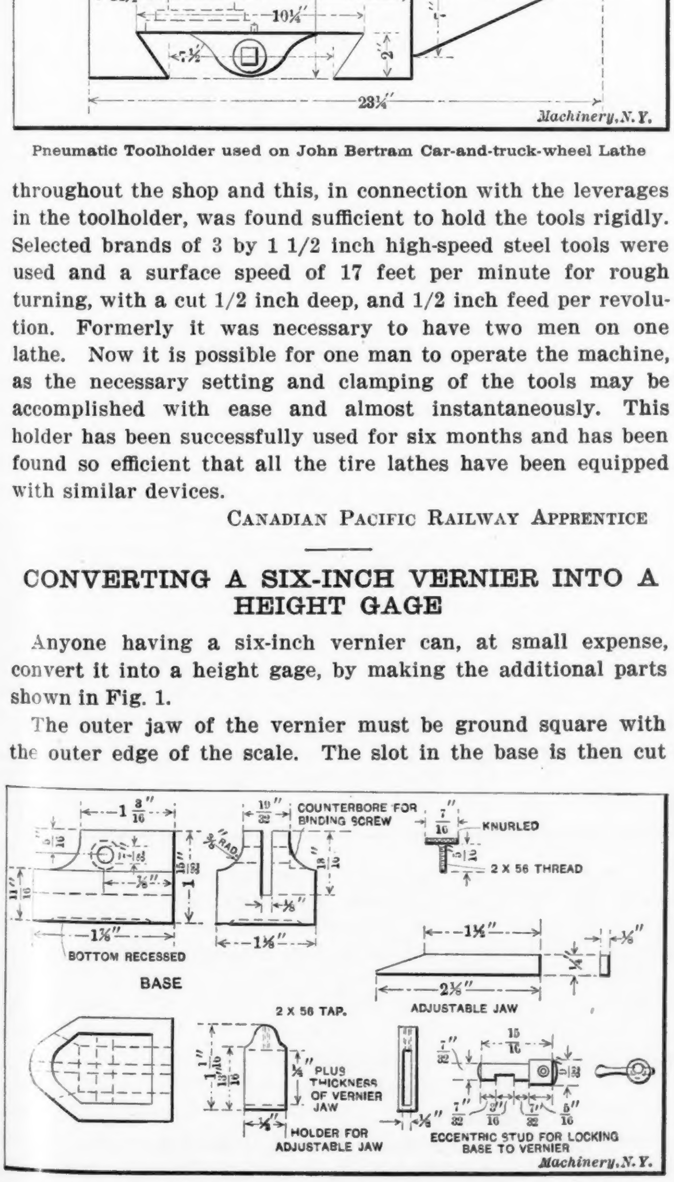


Fig. 1. Parts used for Converting a Six-inch Vernier into a Height Gage

deep enough so that the measurement from the bottom of the base to the inside of the jaw will be ¾ inch, plus allowance to be left for grinding, after the base has been hardened (see Fig. 2). Care must be taken in grinding to get the bottom and sides of the slot parallel and square with the bottom of the base. The slot should be wide enough to permit the solid jaw of the vernier to slide freely without side play. The jaw is then locked to the bottom of the slot by the eccentric binding stud, and the adjustable jaw clamped to the movable jaw of the vernier as shown in Fig. 2, when the gage is then ready for use.

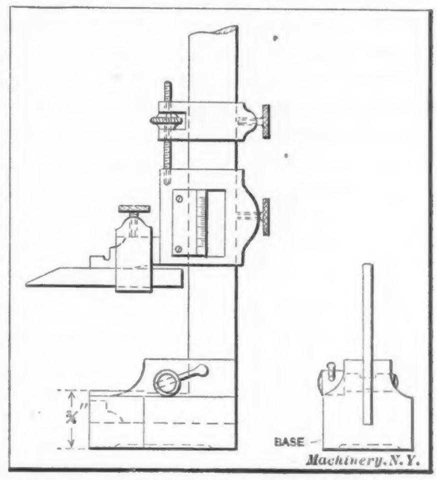


Fig 2. A Six-inch Vernier converted into a Height Gage by using the Additional Parts shown in Fig. 1

W. C. Betz

New Britain, Conn.

A SETTING-UP TIP FOR SCREW MACHINES

In setting up hand screw machines and turret lathes, to obtain the desired length of the finished piece the operator usually keeps cutting off, measuring and adjusting until he arrives at the correct length; or, perhaps, he has a sample of the work to be produced. In this case he places one end of the sample against the cut-off tool and pushes the stop *A* against the other end, and then locks the carriage. See Fig. 1.

In the majority of shops, especially where most of the work is done from blueprints, and samples cannot be obtained, the first method described is in general use. The following method is my suggestion as an improvement: I would suggest the use of a narrow scale or "hook-rule," as it is commonly called. Most firms make this rule so that the hook can be easily removed. Fig. 2 shows how the scale is applied in measuring the length of the piece. One end is placed against the stop in the turret and the other passes into the spindle of the screw machine. The carriage is brought forward and the stop pushes the scale forward until the proper graduation is in line with the outer edge of the cut-off tool, and the carriage locked to the bed.

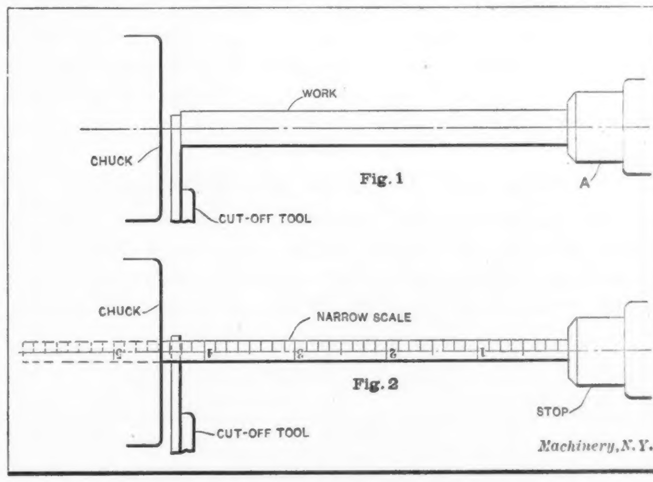


Fig. 1. Using Sample of Work for Setting the Stop. Fig. 2. Using a Narrow Hook-rule for Setting the Stop

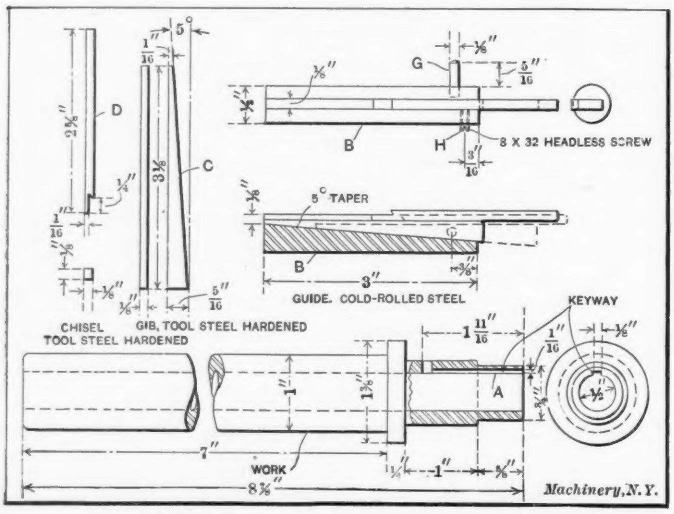
The narrow scale can be used on all work above 1/4 inch diameter, but if the screw machine collet is removed from the spindle, a wide flexible scale may be used instead. It takes but a minute to loosen the chuck cap and remove the collet, and this is done on most set-ups, anyway.

This method of setting up should be appreciated, as it saves time, labor and material, for several pieces are usually made too short when setting up by guesswork.

Designer

CUTTING A KEYWAY IN A SMALL HOLE

The accompanying illustration shows the tools which were used in cutting a keyway in a small hole, which I hope will interest some readers of MACHINERY. It can be seen from the illustration that the hole in the work was ½ inch in diameter and the keyway ⅛ inch wide by 1/16 inch deep. To accomplish this I took a piece of cold rolled steel *B*, ½ inch in diameter by 3 inches long. In this a groove was cut ⅛ inch wide and on an angle of five degrees as shown. A piece of tool steel *C* was then made with an angle of five



A Simple and Effective Device for Cutting a Small Keyway

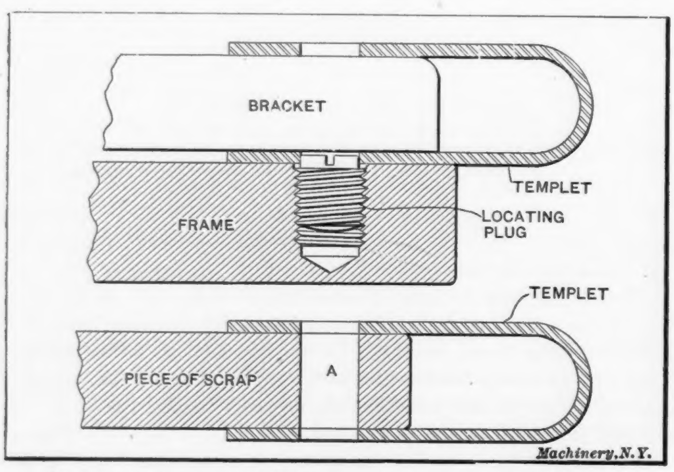
degrees to correspond with the angle on the piece *B*, and then the small chisel *D* was made from tool steel. A small dowel pin *G* was driven in the side of piece *B* to prevent it from being forced into the hole while cutting the keyway, and on the opposite side of the piece *B* a small headless screw *H* was used, which prevented the gib from slipping when the chisel was being driven on top of it. It can be seen that by releasing the headless screw the gib *C* can be moved forward a slight amount for each cut, and then the screw can be tightened, thus preventing it from going any further than the distance desired. This device worked very satisfactorily.

HARRY M. FOSTER

Belvidere, Ill.

LOCATING HIDDEN BOLT HOLES

In the August number of MACHINERY the writer described several methods of locating hidden bolt holes. The accompanying illustration shows another method which many mechanics consider far superior to the ones previously mentioned. The way in which this method is employed is as follows:



Locating the Position of Hidden Holes by means of a Bent Templet

Having obtained a piece of sheet metal of convenient width and length, bend it over somewhat in the shape of the letter U, with an opening sufficient to fit over the bracket in which the hole is to be located. Then take a piece of scrap which will just fill this opening. Place them together and drill a hole the proper size through the three sections as shown at *A*. This will bring the two holes in the templet in line, and at right angles to the flat surfaces. The templet is now placed over the bracket in the manner shown in the sketch and located with a plug of the proper size which is fitted into the tapped hole. With the parts located in this manner the position of the hole to be drilled through the bracket can easily be scribed by means of the templet.

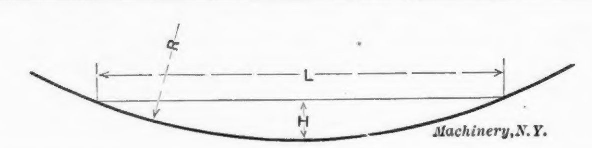
H. E. WOOD

Newark, N. J.

RADII OF CURVES

It is often necessary to find the radius of a large curve, the center of which is not accessible, the curve being, for example, a plate bent to partly cylindrical shape, a spherical end plate, or a templet for a brick arch. There are several ways of finding the radius, a common method being of taking a straightedge or a piece of string of an convenient length, placing it on the curve and measuring the height *H* (see notation in illustration above the accompanying table) between the straightedge and the middle part of the curve.

TABLE OF RADII FOR GIVEN CHORDS AND HEIGHTS OF ARCS



H Inches	Radius L = 6 feet		Radius L = 4 feet		H Inches	Radius L = 6 feet		Radius L = 4 feet	
	Feet	Inches	Feet	Inches		Feet	Inches	Feet	Inches
$\frac{1}{4}$	216	0	....		$8\frac{1}{4}$	6	$10\frac{5}{8}$	....	
$\frac{1}{2}$	108	0	....		$8\frac{1}{2}$	6	$8\frac{1}{2}$	....	
$\frac{3}{4}$	72	0	....		$8\frac{3}{4}$	6	$6\frac{7}{16}$	....	
1	54	$\frac{1}{2}$	24	0	9	6	$4\frac{1}{2}$	....	
$1\frac{1}{4}$	43	3	19	3	$9\frac{1}{4}$	6	$2\frac{11}{16}$	....	
$1\frac{1}{2}$	36	$\frac{3}{4}$	16	1	$9\frac{1}{2}$	6	1	....	
$1\frac{3}{4}$	30	$11\frac{1}{4}$	13	$9\frac{1}{2}$	$9\frac{3}{4}$	5	$11\frac{1}{2}$	....	
2	27	1	12	1	10	5	$9\frac{13}{16}$	....	
$2\frac{1}{4}$	24	0	10	9	$10\frac{1}{4}$	5	$8\frac{3}{8}$	....	
$2\frac{1}{2}$	21	$8\frac{1}{2}$	9	$8\frac{1}{2}$	$10\frac{1}{2}$	5	$6\frac{31}{32}$	....	
$2\frac{3}{4}$	19	9	8	10	$10\frac{3}{4}$	5	$5\frac{11}{16}$	....	
3	18	$1\frac{1}{2}$	8	$1\frac{1}{2}$	11	5	$4\frac{13}{32}$	....	
$3\frac{1}{4}$	16	9	7	$6\frac{1}{2}$	$11\frac{1}{4}$	5	$3\frac{7}{32}$	....	
$3\frac{1}{2}$	15	7	7	0	$11\frac{1}{2}$	5	2	....	
$3\frac{3}{4}$	14	8	6	7	$11\frac{3}{4}$	5	1	....	
4	13	8	6	2	12	5	0	....	
$4\frac{1}{4}$	12	$10\frac{1}{2}$	5	10	$12\frac{1}{4}$	4	$11\frac{1}{16}$	....	
$4\frac{1}{2}$	12	$2\frac{1}{4}$	5	$6\frac{1}{2}$	$12\frac{1}{2}$	4	$10\frac{3}{32}$	....	
$4\frac{3}{4}$	11	$5\frac{3}{4}$	5	3	$12\frac{3}{4}$	4	$9\frac{7}{32}$	....	
5	11	0	5	0	13	4	$8\frac{11}{32}$	....	
$5\frac{1}{4}$	10	6	4	$9\frac{1}{2}$	$13\frac{1}{4}$	4	$7\frac{9}{16}$	....	
$5\frac{1}{2}$	10	$\frac{1}{2}$	4	7	$13\frac{1}{2}$	4	$6\frac{3}{4}$	....	
$5\frac{3}{4}$	9	$7\frac{1}{2}$	4	5	$13\frac{3}{4}$	4	$6\frac{1}{32}$	....	
6	9	3	4	3	14	4	$5\frac{9}{32}$	....	
$6\frac{1}{4}$	8	$10\frac{3}{4}$	4	$1\frac{1}{4}$	$14\frac{1}{4}$	4	$4\frac{5}{8}$	....	
$6\frac{1}{2}$	8	7	3	$4\frac{1}{2}$	$14\frac{1}{2}$	4	$3\frac{15}{16}$	....	
$6\frac{3}{4}$	8	$3\frac{1}{4}$	3	10	$14\frac{3}{4}$	4	$2\frac{29}{32}$	....	
7	8	0	3	$8\frac{3}{4}$	15	4	$2\frac{11}{16}$	....	
$7\frac{1}{4}$	7	9	3	$7\frac{1}{2}$	$15\frac{1}{4}$	4	$1\frac{13}{16}$	....	
$7\frac{1}{2}$	7	$6\frac{3}{16}$	3	6	$15\frac{1}{2}$	4	$1\frac{9}{16}$	....	
$7\frac{3}{4}$	7	$3\frac{1}{2}$	3	5	$15\frac{3}{4}$	4	$\frac{29}{32}$	....	
8	7	1	3	4	16	4	$\frac{1}{2}$	....	

The radius can now be found by laying out the chord and the height on drawing paper, and, after having found the radius by trial, measuring it directly on the paper. A more accurate method is to calculate the radius from the formula:

$$R = \frac{H^2 + l^2}{2H}$$

in which R = radius of curve or arc,
H = height of circular arc,
l = one-half the chord.

This formula, in the same or slightly modified form, may be found in any mechanical engineer's hand-book. The accompanying table is calculated by this formula, assuming

the length of the chord to be 6 or 4 feet, with a height H varying from ¼ to 16 inches. The body of the table gives the corresponding radii in inches.
A. WIND
Penn, Wolverhampton, England.

TURNING LONG SLENDER WORK

Turning long, slender work is a very difficult job on an ordinary engine lathe, but it can be accomplished with comparative ease when the tools here shown are used. At Fig. 1 is shown the piece which is to be turned, and it will be seen that the diameter is to be reduced from 0.187 inch to 0.096 inch for a distance of 3 11/16 inches. The die shown at Fig. 2 accomplished this in a satisfactory manner. This die is made similar to an ordinary threading die, except that it is not threaded, but is recessed as shown, the recess acting as a

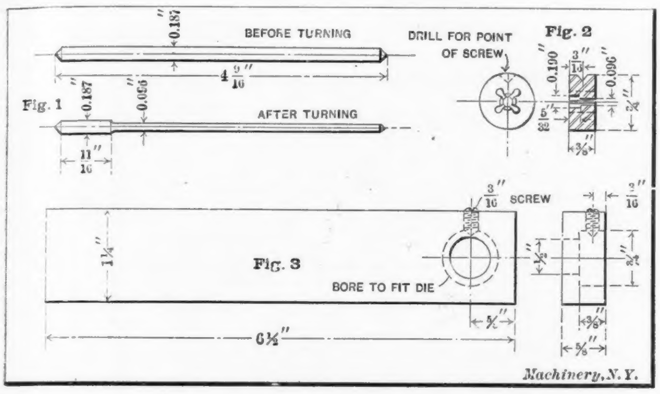


Fig. 1. Work before and after Turning. Fig. 2. The Turning Die. Fig. 3. Toolholder in which the Die is held

guide for supporting the work while being turned. The die is held in a piece of stock, Fig. 3, which, in turn, is held in the toolpost of the lathe. The piece to be turned, Fig. 1, is held in a chuck or collet held in the spindle of the lathe. The turning of the piece is accomplished as follows:

The die is inserted in the counterbored recess in the holder shown and held with a small headless screw. Then the holder Fig. 3 is set square with the faceplate of the lathe and the hole in the die set concentric with the piece to be turned by bringing the tapered end gently up against the flutes, allowing the spindle to revolve, and taking a light cut. The die and holder can then be drawn back, and if found to be cutting exactly right, the feed is thrown in and a good supply of oil used. After turning, if the piece is found to be small at the end nearest the chuck it is an indication that the die has been either set too high or too low, or to one side. By adjusting the die in the right direction this can be remedied. Pieces 11 inches long, of small diameter, have been successfully turned with this method, and although they are sometimes liable to bend slightly in advance of the die while turning, it will be found after cutting that they are perfectly straight.
M. H.

A COMBINATION HEAD FOR POLISHING AND LAPPING

The accompanying illustration shows a head which will be found very convenient in small shops for lapping and polishing small parts. The manner in which this head is made is as follows:

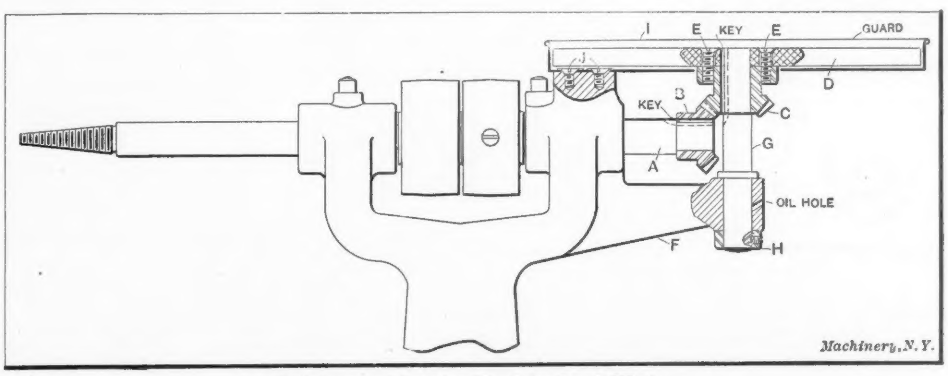
A spindle A as shown extends through the bearings and has fastened to it a loose and a tight pulley. To the left of the engraving is the arbor for holding the polishing brush or wheel, and to the right is shown a metal lap. On the end of the shaft A is keyed the bevel gear B, as shown, and this meshes with the bevel gear C which is attached to the metal lap D by means of the flat-head screws E. The bracket F, as shown, holds the vertical shaft G to which the bevel gear is keyed. A washer H is used at the lower end to prevent the bevel gears from getting out of mesh. A guard I is fastened to the head by two flat-head screws J, as shown. This guard keeps the oil and emery from flying around. It is obvious that when operating the lap, a slower speed will be necessary than when using the buffing wheel. This lap will be found very satisfactory if well made, and will be a valuable addition to any small shop.

Buffalo, N. Y.
L. H. GEORGER

CONDUCTING A SUGGESTION DEPARTMENT IN THE SHOP

Every progressive company should encourage among its employes the practice of making suggestions for improvements in regard to their manufacturing methods, and at the same time give them the advantage of such suggestions as may be found helpful.

As many of the operators in every factory, by reason of their close contact with the work, can suggest improvements in methods and equipment or in some cases additions to the machinery and special tools, which would not occur to those not having their peculiar opportunities, they should have the advantage of suggesting what they think in regard to such matters. The company should post circulars in various departments outlining the principles and plan of operation of a suggestion department. A locked box should also be provided and placed in an accessible position where the employes may deposit their suggestions. These suggestions should be written out, and a carbon copy made of them, but the writer should not sign his name, retaining the carbon copy as proof that he was the originator of the suggestion. As often as convenient these suggestions should be taken up by the judges and considered. Preferably there should be five judges, consisting of the president of the company, he being president of the board, general superintendent, master mechanic and any other two officers whom they may consider advisable to have as members of the board. If these judges find any of the suggestions to be of sufficient value to warrant their adoption, wholly or in part, prize money should be distributed to those who have offered the suggestions.



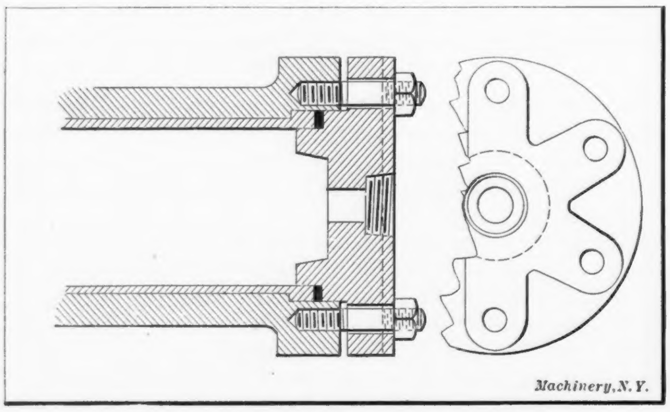
Polishing and Lapping Head for Small Work

Suggestions for which prizes are to be given should be posted where they may be seen by all concerned and the employe who has offered the suggestion may present his carbon copy and receive the prize to which he is entitled by the decision of the judges. The following employes of the company should not be allowed to participate in offering suggestions: The superintendent, foremen, mechanical, electrical and civil engineers, draftsmen, and others who may be employed in designing or having other executive positions throughout the works. Only those who have no other means of offering suggestions, and have no other opportunity for testing their original ideas should be allowed to participate. This in many cases will be found an incentive to the men and draw out some ideas that might be of special value to the company in regard to their manufacturing methods.
ARTHUR Z. WOLGAMOT
Peoria, Ill.

IMPROVED HYDRAULIC CYLINDER LINER

In reading the August number of MACHINERY, I was very much interested in the improved hydraulic cylinder liner which

was described by Mr. Brownstein. I think it is a step in advance of the old-style method which he described in Fig. 2, but why not take a few steps further? I apprehend that there is a chance of the improved packing blowing out. In fact, I have seen that type of packing blow out when it was put in by a careless workman, and as I have had considerable experience in this line, I would suggest that the method shown in the accompanying illustration be used, as I have found it to work very satisfactorily. It will readily be seen that this design if



Method of Inserting Packing so that it cannot blow out

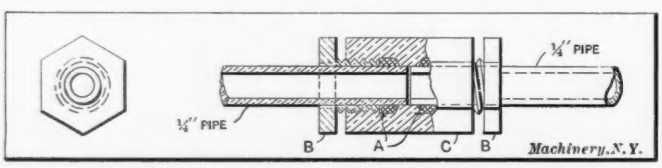
properly fitted will not admit of the packing blowing out. In fact, the packing is so hemmed in that even if it was not fitted with extreme care, it would seldom give any trouble. In this case, it is advisable to use sheet lead instead of copper, as it lessens the expense. This can be used satisfactorily when a design of this description is adopted.

It will be noticed in the engraving that the cap is ribbed, thus saving metal. All that is required is just enough metal to overcome the strain plus a certain factor of safety. After that all the surplus metal put in a casting is waste.

Newark, N. J. H. E. Wood

STUFFING-BOX CONNECTION FOR SMALL PIPES

The accompanying illustration shows a method for connecting small pipes which was found very satisfactory. The stuffing-box *A* has a hole drilled through it which should preferably be reamed. It is then tapped in each end to fit the



A Simple and Effective Connection for Small Pipes

glands *B*. At the front end of these glands a lead strip *C* is wound around the pipe so that when the glands are screwed up tight they compress this lead, thus making a steam- or water-tight joint. Where the space is limited, the glands can be made without a head, being flush with the ends of the part *A*, and two small holes drilled in the end of them so that they may be tightened by a spanner, thus reducing the length of the stuffing-box, which is sometimes necessary.

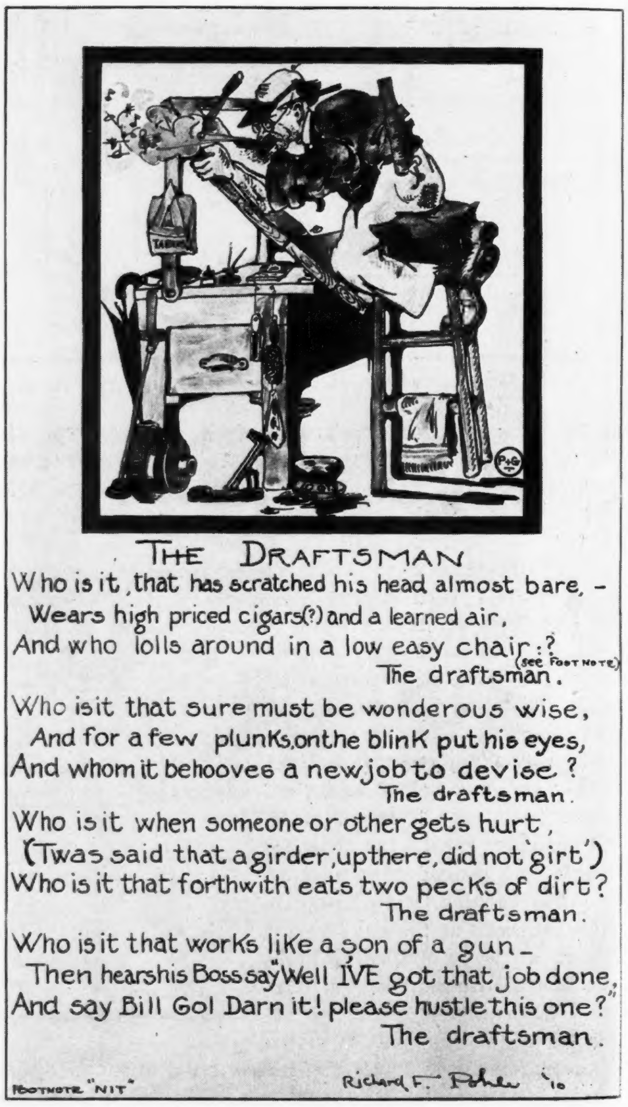
Buffalo, N. Y. Charles Weslow

STARTING A DRILL IN THE LATHE

In boring holes in work which is held in a chuck, it often happens that the hole must go through solid stock, consequently the greater part of the stock must be removed with a drill held in a suitable holder in the tailstock or in a chuck. In most cases it is the practice of nearly every one to make a countersink in the work with a tool held in the toolpost, which is commonly called a centering tool. This gives the drill a chance to start and keeps it concentric with the work. This method involves very accurate grinding and locating of the tool, and, except in certain cases, it is unnecessary. I have found that a very quick and accurate method of centering the drill in the work, is to face the work off square, not making any countersink whatever; placing the drill in the chuck or holder, as the case may be, and centering the drill as near as possible. Then select a lathe tool that is square across the back end and place it in the toolpost so that it will clear the end of the work and be in such position that when fed forward it will bear against the lip of the drill until it appears to be central. Then start the lathe; feed the drill in a little, as is necessary to get the central position, back the tool away from the drill and if it is central proceed to drill the hole; if not repeat the operation again. This procedure is followed until the drill begins to cut to the full size. After a little practice this method can be used unless the drill is very small or in case the work projects so far from the chuck that it has a tendency to spring.

Webber, Kan. J. N. Bagley

THE DRAFTSMAN



* * *

Cast nickel-bronze gears are, according to *Castings*, employed in certain cases in which cast-iron gears have not the necessary strength and toughness, and cast-steel gears are unsatisfactory on account of their lack of uniformity. The alloy for these gears consists of 86 per cent of copper, 10 per cent of tin, 3 per cent of nickel, and 1 per cent of 5 per cent phosphor-tin. The nickel is melted with about 25 per cent of the copper, after which the rest of the copper is added. Then the tin is added, and finally the phosphor-tin, the mixture being well stirred.

* * *

The Cunard steamer *Mauretania* made the western passage over the Atlantic on the short course of 2780 knots in four days, ten hours, and forty-one minutes, arriving in New York September 15. This record is ten minutes less than the *Mauretania's* best previous record.

NEW MACHINERY AND TOOLS

A MONTHLY RECORD OF APPLIANCES FOR THE MACHINE SHOP

Comprising the description and illustration of new designs and improvements in American metal-working machinery and tools, published without expense to the manufacturer, and forming the most complete record of new tool developments for the previous month.

CINCINNATI UNIVERSAL GRINDING MACHINE

The universal grinding machine, front and rear views of which are shown in Figs. 1 and 2, respectively, is the product of the Cincinnati Grinder Co., Cincinnati, O. This machine is adapted to the grinding of cylindrical work (either straight or taper), chuck and faceplate work (either internal or external), and, in addition, it can also be used to advantage for grinding gages, dies, jigs and fixtures and other miscellaneous work found in the average shop and manufacturing plant.

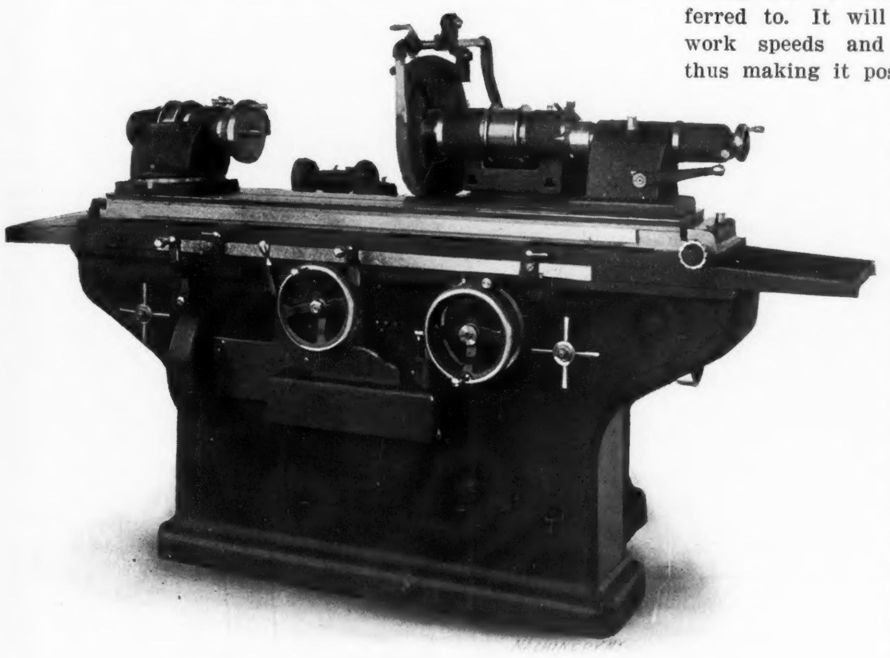


Fig. 1. Universal Grinder built by the Cincinnati Grinder Co.

This grinder is fitted with speed and feed boxes that enable the operator to obtain instantly, from a central position in front of the machine, any speed or feed with which the machine is provided, thus eliminating overhead cone pulleys and mechanical speed-changing devices. The entire overhead works required for driving this machine consists of a drum and a single shaft carrying four pulleys; the headstock has only one pulley for both live- and dead-center grinding. The table has a variable tarry at points of reversal, and the wheel is provided with an automatic cross-feed and a positive stop for use in the production of duplicate diameters.

The feeds and speeds of the table and work spindle are regulated by the two speed change boxes shown attached to the rear of the machine in Fig. 2, the one to the right being for the table feed, while the one to the left regulates the work speed. The drive is through the upper pulley to the right, which is mounted on a shaft that transmits power to both speed boxes. The different feed and speed changes are controlled by the small pilot wheels shown at the right and left sides of the machine in Fig. 1. These wheels are mounted on shafts which pass through the bed and on the ends of which are pinions meshing with rack teeth cut in the sliding members to which the diving keys of the change gears are attached. One of these connecting shafts is clearly shown in Fig. 2, while Fig. 3 shows a sectional view of the speed-change box through which the overhead drum for the headstock spindle is driven. This illustration shows clearly how the speed changes are obtained by shifting the diving key by means of the rack-and-pinion movement referred to. It will be seen that by this arrangement, the work speeds and table feeds are entirely independent, thus making it possible to use the correct table feed for a given work speed. A single lever, convenient to the operator, furnishes means for instantly starting or stopping the rotation of the work and the travel of the table in conjunction with each other.

The wheel-stand slide, which is mounted upon long and wide ways, is so arranged as to preclude the possibility of any jumping or sticking action or of lifting under heavy cuts. This slide swivels and it has a graduated base. The transverse movement is controlled and adjusted by a handwheel on the front of the machine, which is graduated to read in thousandths of an inch on the diameter of the work. A finer hand-feed, graduated to read in quarter thousandths on the work diameter, is available by locking the automatic cross-feed and turning the thumb-wheel to obtain the adjustment required. The wheel-stand is amply proportioned to resist the most severe service, and it is rigidly supported by a pedestal which is cast integral with the base and extends to the floor. The wheel spindle runs in phosphor-bronze boxes that are provided with means of compensating for wear. It is made of carbon steel and is hardened, ground and lapped.

The automatic cross-feed covers a range varying from 0.00025 inch to 0.005 inch at each reversal of the table, thus giving feed changes fine enough for producing a high finish on delicate work and coarse enough for the rapid removal of stock

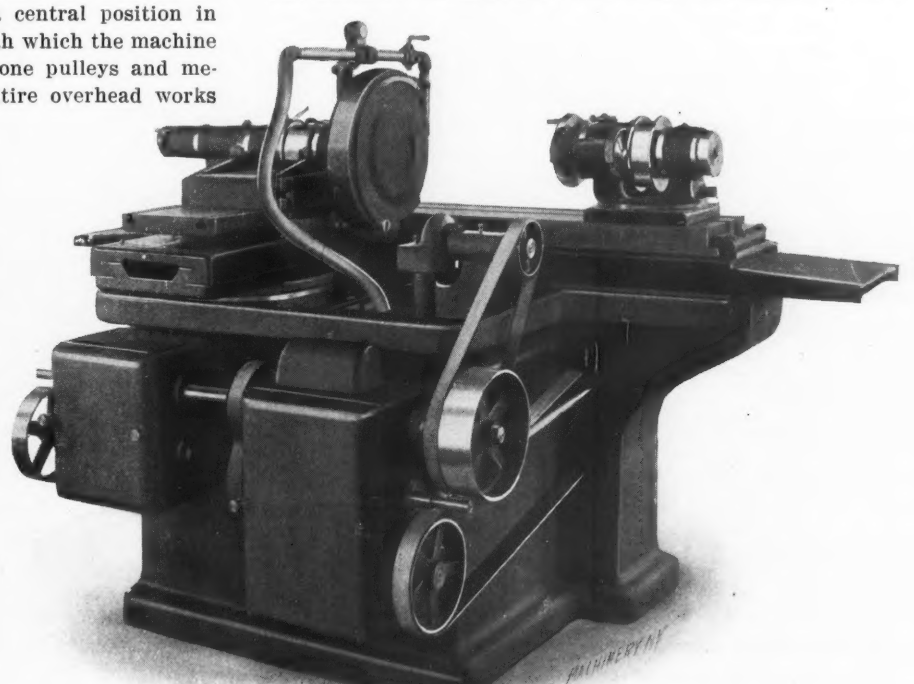


Fig. 2. Rear View of Grinder showing the Feed and Speed Boxes

on heavier parts. This feed can be set, of course, to automatically disengage when the work has been reduced to the required size, and it is regulated by the simple turning of a thumb-wheel that is conveniently located.

The table has a reciprocating motion on the ways of the main base casting that is controlled by adjustable dogs operating against a reversing lever which actuates a clutch of the load-and-fire type contained in the automatic feed-plate. The latter is a complete unit that is bolted to the front of the ma-

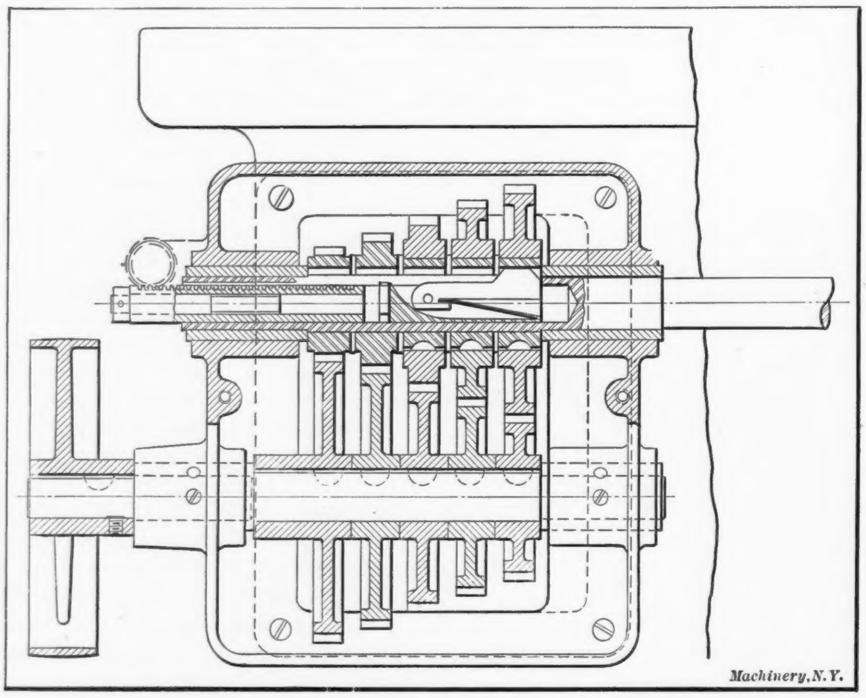


Fig. 3. Sectional View of One of the Speed Boxes

chine so as to be readily removed at any time. As before stated the table travel is entirely independent of the work speeds or the speed of the wheel, which permits traversing the work at each revolution a distance equal to the full width of the wheel face—a desirable feature when removing stock rapidly. The swivel table, which is mounted on the sliding table, pivots on a large, hardened and ground central stud. The swivel table can be set at an angle with the ways when grinding tapering work. It is graduated to read in degrees and taper in inches per foot. The adjustment is made by rack and pinion at the right end of the table, and the direct reading scales indicate its position. When it is necessary to move the

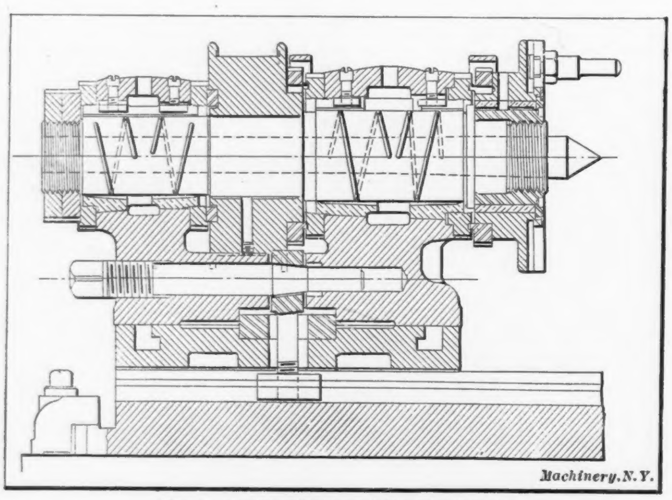


Fig. 4. Sectional View of the Headstock

table through a greater distance than that covered by the graduation marks, no special disconnection is necessary as the adjusting device is so designed that it leaves the table free to swivel through an arc limited only by the wheel-slide.

The headstock, a sectional view of which is shown in Fig. 4, swivels, has a graduated base, and is locked to the swivel table by means of a large stud-bolt sliding in a T-slot. This bolt and the conically-ended screw by which it is tightened, are clearly shown in the engraving referred to. The spindle is hollow, hardened, ground and lapped and runs in bronze boxes which are provided with means for taking up wear. The work is revolved through gearing when grinding on dead centers, which transmits motion from the single pulley to the faceplate. When it is desired to grind on live centers, the pulley is locked to the spindle. The headstock is kept in alignment by the use of an inverted V of the lathe type, which is depressed so that it does not project above the table surface and thus interfere with the clamping of attachments.

The footstock, which is shown in Fig. 5, is kept in alignment on the table in a manner identical to that of the headstock, and it is also clamped in position by a stud-bolt which slides in a T-slot in the table. A diamond holder which may be used for truing the wheel without removing the work, is attached to the end of the footstock spindle as shown. The spindle is hollow and it is bored to the same taper as the spindle of the headstock. It is so designed as to be operated by a handwheel or quick-acting spring, controlled by a lever.

The base of this grinder has a three-point bearing in order to compensate for any uneveness in the flooring and to maintain perfect alignment. It is of box section, thoroughly ribbed and braced so as to offer resistance to torsional strains. The back-rests furnished with these machines for supporting slender work, take up the reduction in grinding, are rigid, capable of delicate adjustments, and are universal in their movements. The construction of one of these rests is shown in Fig. 6. The pump, the drive for which is clearly shown in Fig. 2, is of the well-known centrifugal type which revolves horizontally in a case immersed at all times, thus obviating the necessity of priming.

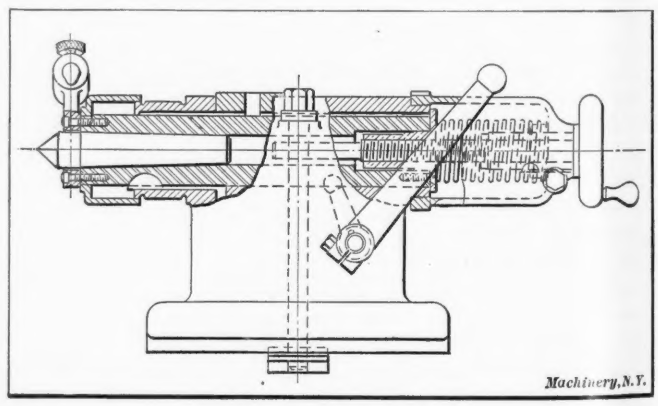


Fig. 5. The Footstock

The water tank is cast integral with the base, the arrangement being such that the pump bearings do not come in contact with the water. Water guards are provided which catch the spray and waste water when wet grinding, and return it to the settling tank and pump.

These machines are built in four sizes, the principal dimensions of the No. 1 or smallest, and the No. 4 or largest being respectively, as follows: Swing over table, 10¾ and 13 inches; maximum distance between headstock and footstock centers, overhung, 34 and 68 inches; number of work speeds, 10; range of work speeds, 25 to 288, and 21 to 242 revolutions per minute; number of table feeds, 10 and 12; range of table feeds, 6 to 66 inches and 6 to 90 inches; horsepower required for driving, from 2 to 4 and from 5 to 8; floor space required, 41 by 96 and 49 by 164 inches.

These grinders are manufactured on the unit system of construction, which eliminates to an appreciable extent, individual fitting and assembling and insures interchangeability of parts. Plain bearings are scraped to master surface-plates and straightedges; shaft bearings are ground and fitted with re-

movable bushings which may be replaced when worn without disturbing the alignment of the shafts, and all sliding surfaces and revolving parts are provided with liberal and efficient means of lubrication. The equipment includes one in-

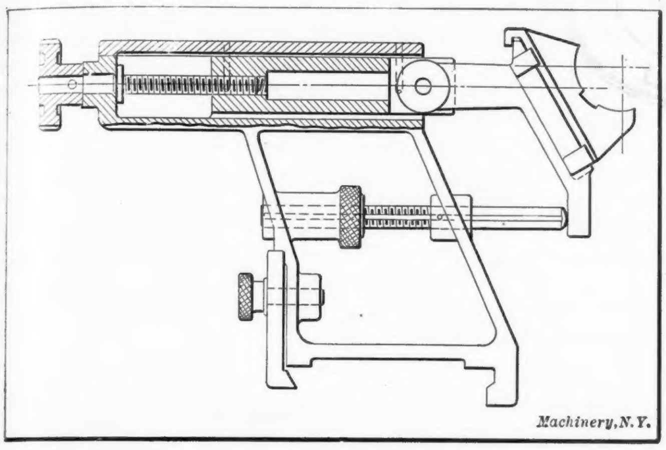


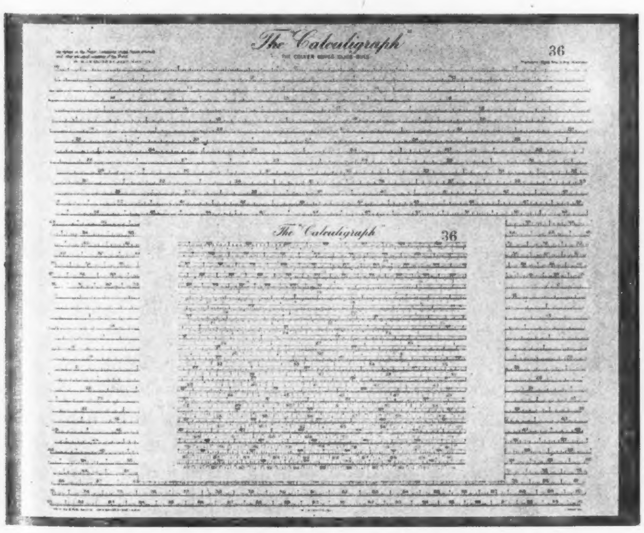
Fig. 6. The Back-rest

ternal grinding fixture, draw-in collet, one three-jawed combination chuck, faceplate, two combination plain and universal back-rests, center-rest, tooth-rest, two grinding wheels, a set of dogs, water guards, and the necessary adjusting wrenches.

THE CALCULIGRAPH OR COLYER-NOYES SLIDE-RULE

The device illustrated herewith is known as the "Calculigraph," and is intended to facilitate the tedious and time-consuming details in connection with mathematical work. This instrument, like similar calculating devices, is based on the well-known properties of logarithms. It consists of two parts, namely a plate 12 by 9½ inches, containing the necessary graduations, and a "bridge" which is shown on the plate in the illustration. This bridge is also graduated and has a series of parallel slots through which results are read directly from the plate. Owing to the large size of the plate, and, consequently, the coarseness of the graduations, a high degree of accuracy in the results is obtained.

When using the "Calculigraph," the upper left-hand corner of the bridge marked with number "10," is always kept in the



Colyer-Noyes 36-inch Slide-rule

upper left-hand quarter-section of the plate, and the slots in the bridge are kept parallel with the lines on the plate. By observing these simple precautions, the operations of division, multiplication and proportion may be readily effected with this instrument.

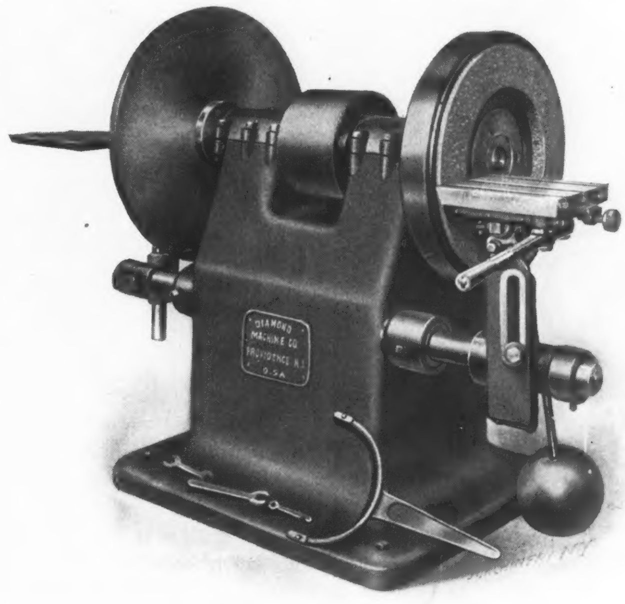
When it is desired to multiply two numbers, the bridge is moved on the plate to such a position that the multiplier lies in the slot immediately above the number "10" on the upper left hand corner of the bridge; the number to be multiplied is then found on the bridge, and immediately above it on the plate will be the result of the multiplication.

For division the bridge is set so that the number upon it corresponding to the divisor, lies immediately below the number "10" in the center of the plate; the number representing the dividend is then found on the bridge, and in the slot immediately above it will be the quotient. As in all similar instruments, the position of the decimal point is not shown by the "Calculigraph," but it is independently determined.

This instrument may be obtained from Kolesch & Co., 138 Fulton St., New York City.

DIAMOND HEAVY DISK GRINDER

The disk grinder shown herewith is particularly adapted for grinding large and heavy work, such as automobile cases, feet of motor frames, etc. This machine has a steel-bound chuck and abrasive ring on one end of the spindle, and a steel disk for emery disks on the other, so that it is adapted to heavy grinding where considerable stock has to be removed, and also for that class of work which can be finished to advantage with a disk. The table on the side of the machine



Diamond Machine Co.'s Disk Grinder

which has the disk, is an ordinary plain table, as this side is not used for such heavy work as the other, and, therefore, a man can hold the work against the disk without excessive fatigue. The other side which has the large abrasive ring wheel, is intended to remove the greater amount of stock and do it more rapidly than the other. Therefore this side of the machine has been equipped with a sliding table operated by a hand lever. The work can be held in any jig, which can be bolted to the T-slots in the sliding table. The sliding table is provided with a micrometer stop for the production of duplicate parts. It is operated by a hand lever which is not only used to bring the work up against the wheel, but also to rock it back and forth over the face of the wheel, thus using the entire surface. The wheel can be dressed quickly and economically by fastening a wheel dresser on the sliding table-top and then rocking the table back and forth over the face of the wheel. The table is balanced by a proper size weight which hangs out of the way below the table-supporting stud. The entire construction of this machine is extremely massive and heavy. The spindle bearings are babbitted and ring oiling. The studs which support the tables are of extra large diameter. All the necessary wrenches, a cement press, and a countershaft are provided with the machine.

The height from the base to the center of the spindle is 36 inches; diameter of the spindle in the bearings, 3 inches; diameter of the disk, 30 inches; size of the emery ring, 22 by 17 by 2½ inches; size of plain table, 14 by 30¾ inches; size of the sliding table, 8½ by 12 inches; weight, crated for shipment, 1500 pounds. This grinder is manufactured by the Diamond Machine Co., Providence, R. I.

COMPOUND TABLE FOR COLBURN HEAVY-DUTY DRILL PRESSES

In the department of New Machinery and Tools for July, 1910, we illustrated and described a heavy-duty drill press built by the Colburn Machine Tool Co., of Franklin, Pa. This company has just brought out a new attachment for this machine, in the shape of a compound table which has both

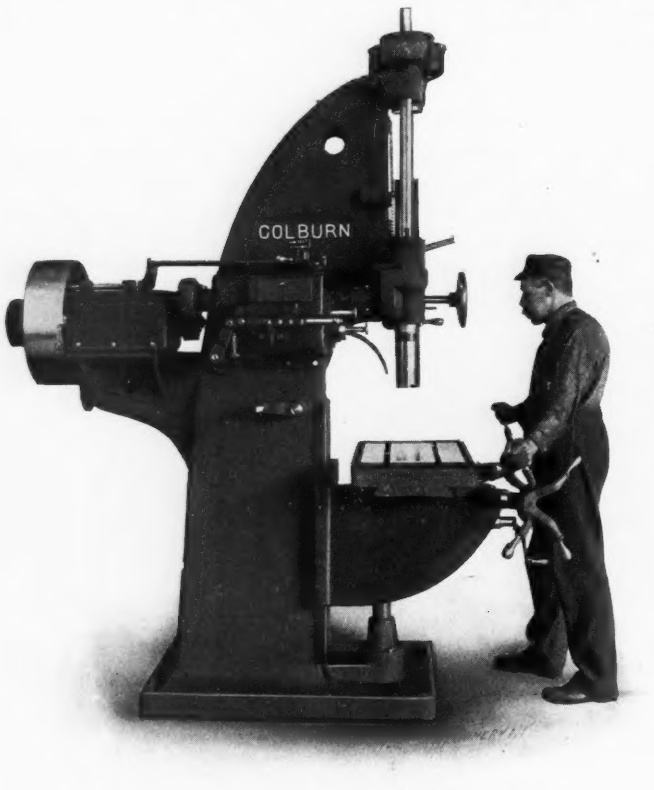


Fig. 1. Colburn Heavy-duty Drill Press with Compound Table

cross and longitudinal movements, controlled by conveniently located pilot wheels.

This table has a rapid movement, through a worm and rack, of 20 inches longitudinally and 8 inches crosswise. The operator, when standing directly in front of the table as shown in Fig. 1, can adjust it in either direction without moving out of his position. It should be explained that this is not an at-

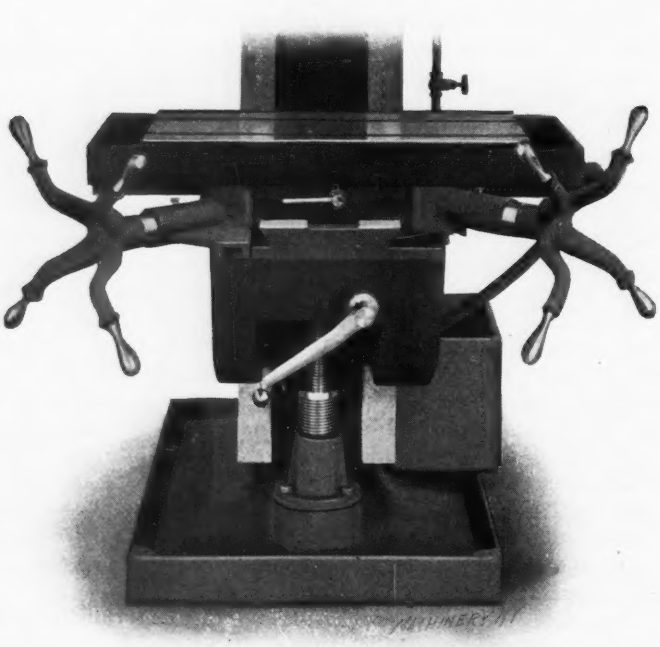


Fig. 2. Front View of the Compound Table

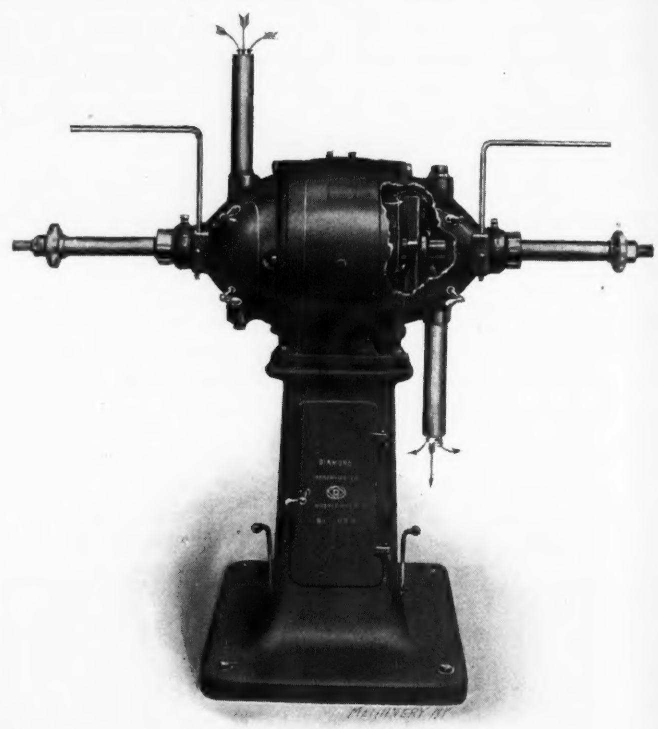
tachment to the regular table, but a special knee and table that is furnished only when so ordered.

The platen of the compound table has a working surface, inside the oil grooves, of 16 by 30 inches, and it contains two large T-slots for the clamping of work. A large chip pan is provided at each end and oil grooves run lengthwise at each side. The design is such that all lubricant running into the pan at the left end is drained back by means of a cored opening through the table, to the chip pan nearest the tank. From this pan the lubricant is conveyed, by means of a hose and suitable connections, to a tank at the side of the machine so that no matter how large a stream of lubricant is used, it all drains back to the supply tank.

In Fig. 2 a detailed view of the table as it appears from the front, is shown. It is evident from the illustrations that it would be impossible for this table to spring, owing to the heavy bracket or knee underneath and the additional support received from the elevating screw. When the compound table is used, the maximum distance between its top and the end of the spindle is 28 inches, which is 6 inches less than when the regular table is employed.

DIAMOND NO. 3 MOTOR-DRIVEN POLISHER

The Diamond Machine Co., Providence, R. I., has recently redesigned its No. 3 motor-driven polisher, shown in the accompanying engraving, with reference to the following points:



Motor-driven Polisher with Cooling Arrangement for the Motor

First, to make the machine self-cooling, and second, to allow it to be operated without opening the door in the column. The first feature has been obtained by placing a fan on the spindle of the machine close to the armature on the outer side of the commutator, and by placing inlets and outlets on the ends of the motor frame. By this means, when the machine is in motion, the fan is constantly drawing cool air through the parts of the motor which ordinarily heat up, and discharging it outside of the machine. The inlet may be connected with the outside air or any place from which clean air can be obtained. The discharge may be carried to a dust collector or discharged any place where the dust is not objectionable.

An electrically-driven polisher or grinder requires that the products of grinding or polishing be kept from the electrical parts as much as possible. In order to do this it is necessary to use an enclosed motor. When the motor is developing a good deal of power, the entire machine necessarily becomes very hot. This undesirable condition is entirely prevented by this arrangement of the fan, together with the inlet and outlet device. This machine is rated at 10 horsepower, and under actual service, for short intervals, it has produced double this

power; as the motor is kept cool it will develop as much power as a like motor entirely open. In previous machines it has been necessary to get inside the column to throw the switch and also to get at the regulator. In this machine a lever projects on each side which can be thrown by the operator's foot thus throwing off the switch. A lever is also provided (not shown in the engraving) for operating the controller. The machine is equipped with bronze ring-oiling bearings each 5 3/4 inches long.

RAHN-CARPENTER EXTENSION-BED GAP LATHE

An extension-bed gap lathe that is designed to meet the requirements of repair and jobbing shops, where a large range and variety of work has to be done at a minimum expenditure for equipment, has been developed by the Rahn-Carpenter Co., of Cincinnati, O.

The top bed of this lathe slides along the lower one and can be adjusted to any width of gap required within the range of the machine. By moving the upper bed, the distance between centers can, of course, also be considerably increased. Both the main bed and sliding member are heavily and substantially constructed and firmly braced throughout their entire length with box girders so that vibration from the heaviest cut is absorbed. The sliding bed is accurately planed and fitted into the lower one, and as the carriage and tailstock are moved along with it, perfect alignment with the head spindle is assured in all positions. The upper bed is moved by means of a coarse pitch screw and handwheel which is located at the end of the lathe.

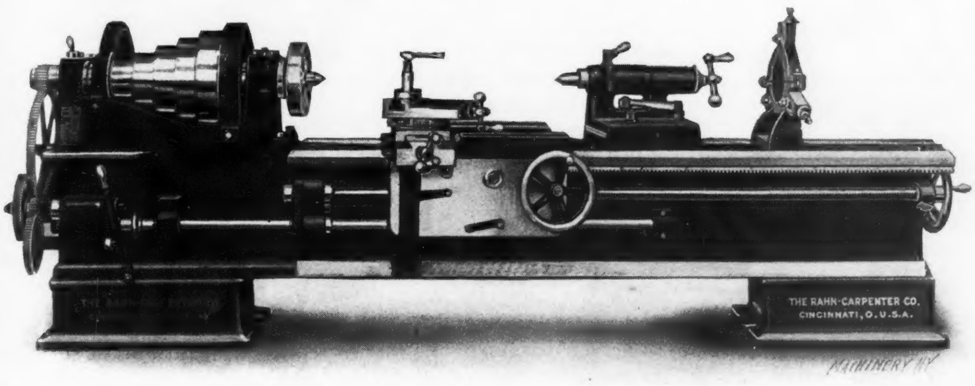


Fig. 1. Rahn-Carpenter 24- and 43-inch Extension-bed Gap Lathe

This machine has a wide range of both longitudinal and cross-feeds, any of which may be instantly obtained by shifting the vertical lever shown connected with the feed box. The positive geared type of drive is employed, and the feeds are so arranged that no two of them can be thrown into operation at the same time. A patented safety device prevents the breaking of gears in the feed box or in the apron through any unavoidable accident or carelessness on the part of the operator. The compound rests and cross-feed screws have graduated micrometer disks for indicating the feeds.

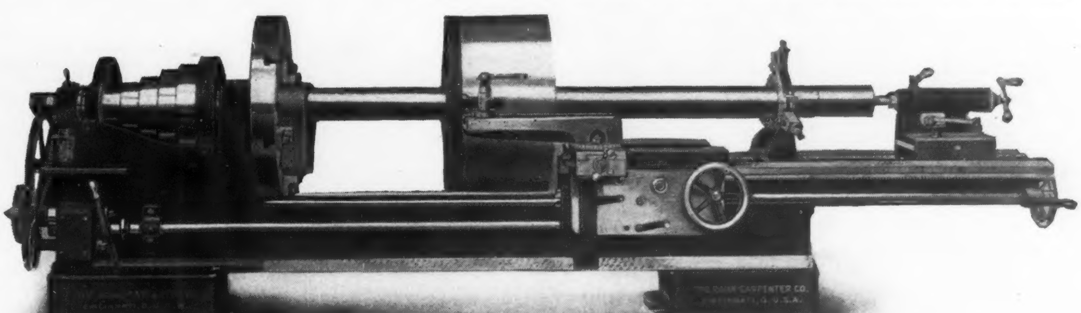


Fig. 2. Gap Lathe with the Gap Open Full Width for Turning Pulley

The headstock of this machine is well ribbed and firmly bolted to the lower bed. The spindle is hollow, is made of a special carbon steel and is finished by grinding. The boxes are made of the best gun metal and are provided with means for taking up any wear which may occur. The driving cone is of extra large diameter, powerfully back-geared and capable of using a broad belt. This lathe can also be equipped with a three-step cone and double back-gear when this is desired. As the engravings show, the tailstock is of the offset type, which allows the compound rest to be swung around parallel to the bed.

The compound rest is rigid and has a long broad bearing on the carriage. The swiveling base is graduated, and gibs are provided for taking up all wear. The carriage is gibbed to the bed both front and back, and provides a broad bearing for the rest. It has a long bearing on the bed and can be firmly locked to the latter for cross-feed work. The construction is such that the tool-rest can be brought close to the gap when required. The front of the carriage is extended and firmly braced, thus allowing extra travel for the compound rest in order that the tool may be operated on the largest diameter that can be swung in the gap. The apron is simple in its design, and the various controlling levers are conveniently placed. The rack and all gears are made of steel, and the stud-pins are hardened and ground.

The countershaft has double-friction clutch pulleys of powerful design. Ample oiling facilities are provided and the shaft runs in self-oiling boxes. The equipment regularly supplied with this lathe consists of a countershaft, steady-rest, follow-rest, and large and small faceplates, wrenches, and a full set of change gears. If desired, a taper attachment, extension turning rest, turret on the carriage, chucks, chuck-plates, turning tools, faceplate chuck or any special tool-rest can be furnished extra.

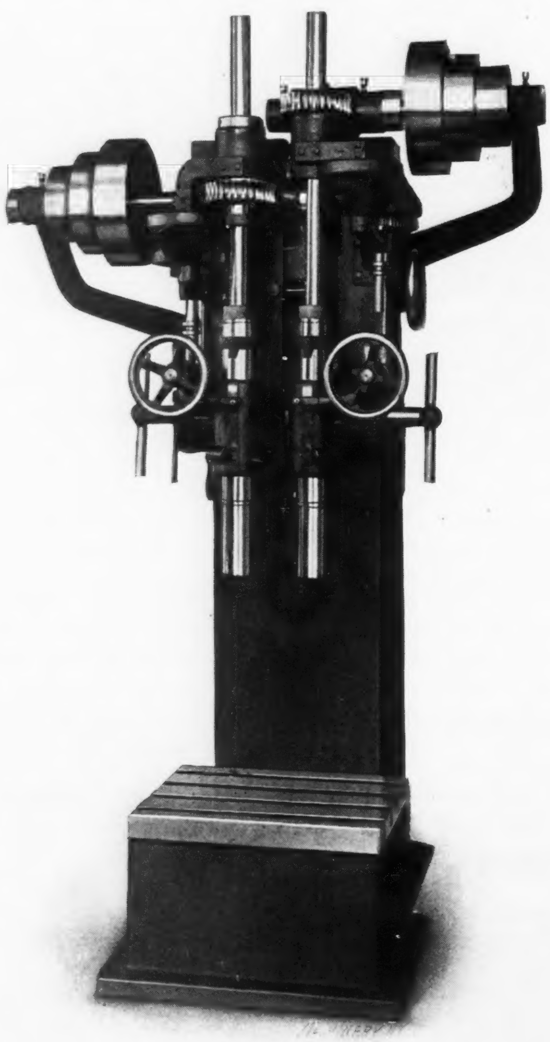
This lathe swings over the gap, 48 inches; over the V's, 27 inches; over the carriage, 19¼ inches, and over the rest, 17¾ inches. The extreme width of the gap with a 10-foot bed is 3 feet. The floor space required for the 10-foot machine is 10 feet by 2 feet and the weight 7000 pounds. There is a feed range of from 0.01 to 0.27 inch and a thread-cutting capacity of from 2 to 20 threads per inch.

HOEFER DRILLING, BORING, FACING AND TAPPING MACHINE

The machine shown in the accompanying engraving is another addition to that line of special machinery that has been brought out to meet the demand of automobile manufacturers and others for tools particularly adapted to a certain class of work, in order to secure rapidity of production and accuracy. This machine is built by the Hoefer Mfg. Co., 120 Jackson St., Freeport, Ill., and it has been specially designed for drilling, boring, counterboring and accurately tapping the inlets of automobile engines. These inlets have heretofore been machined on stock tools which, not being particularly adapted for the purpose, were necessarily slow as they lacked the convenience of manipulation found in a special machine. Furthermore, when tapping the inlets on stock machines which are fed by the lead of the tap, the threads are

liable to be stripped unless precaution is taken. With this special machine the tap is fed positively so that there is no stripping of the thread.

The column of this machine is of the box type to which a stationary base is attached. On the upper end of the column a gibbed cross-rail is attached, to which the two spindle heads are gibbed. The spindle head to the right is permanently fastened on the cross-rail, while the one to the left may be adjusted horizontally on the rail by means of a screw so that centers of various distances may be obtained. The spindles are driven by three-step cones through steel worms and bronze worm-gears. The worms are supplied with ball bearing end-thrusts and run in an oil bath. The spindles are made of the best crucible spindle steel and run in bronze-bushed bearings. As before stated, they are fed by a positive geared feed, and are automatically tripped at any predetermined point. For tapping, the necessary change gears for giving the spindles a feeding movement equal to the tap lead, will be supplied. Each spindle is driven, and is also fed, independently of the other, and each has a hand-feed and quick-return lever. The feed gears have four independent changes that are obtained by a lever, convenient to the operator, which swings against an index-plate giving the desired feeds in thousandths. One of the commendable features of this machine is that it requires only 30 to 45 inches floor space, as all the belting is overhead. While this tool is especially designed for the purposes mentioned in the foregoing, it can, of course, be employed to advantage on many other parts where boring, drilling and tapping is required, within the capacity of the machine.

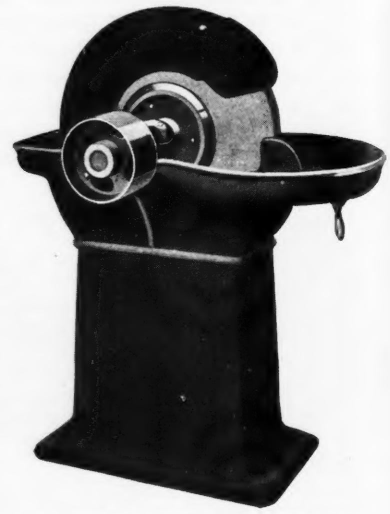


Hoefer Drilling, Boring, Facing and Tapping Machine

The minimum distance from center to center of the spindles is 4⅝ inches, and the maximum distance, 8 inches. The minimum distance from the spindles to the table is 12 inches, and the maximum distance, 28 inches. The vertical feed of the spindles is 16 inches, and the distance from their centers to the column, 12 inches. The feed of the spindles per revolution, is 0.008, 0.016, 0.0315 and 0.0625 inch, but this range can be changed to any feed desired. The spindle is fitted with a No. 5 Morse taper, and its diameter is 2 1/16 inches. The size of the table is 18 by 24 inches, and the greatest height from the floor to the top of the machine is 81 inches.

HOYSRADT & CASE WET TOOL GRINDER

The aim in the construction of the wet tool grinder shown in the accompanying engraving, has been to build, at a moderate price, a simple and efficient tool in which an even and steady flow of water could be maintained upon the wheel without the use of a pump. The water in this grinder is contained in the hollow head (the wheel running in a separate trough) and through a hollow bronze connection, water to any desired amount can be supplied to the wheel. In fact, these grinders can be used either wet or dry by simply shifting the lever seen beneath the bowl at the front. Self-oiling and dirt-proof bearings are employed on the grinder and also on the countershaft. It is claimed that three or four oilings a year will keep these bearings running perfectly. The countershaft is also supplied with a patented self-oiling loose pulley. These grinders are built in two sizes, having 16- and 24-inch wheels, respectively, and the builders are Hoysradt & Case of Kingston, N. Y.



Hoysradt & Case Wet Tool Grinder

PEASE MOTOR-DRIVEN CUTTING AND TRIMMING TABLE

A motor-driven cutting and trimming table that will be found of great convenience and utility for the trimming of blueprints and also for cutting tracing paper or cloth, detail paper, etc., is shown in the accompanying halftone. This table is provided with a parallel clamp, operated by a foot-treadle, which holds the paper, tracing cloth or print securely, while the revolving cutting knife is being used. The device is rapid and convenient in its operation, and it will trim a very narrow strip from the paper or print. As the engraving shows, the revolving cutting knife is motor-driven, the rotation being positive by mechanical means. The thinnest paper may be cut perfectly with this table, and from five to ten sheets may be severed simultaneously. The knife is electrically operated in either direction at will, and it is stopped or started by a specially-designed wrist-controlled switch, which leaves both hands of the operator free for handling the paper or prints.

Table for Cutting or Trimming Blueprints, Tracing Cloth, etc.

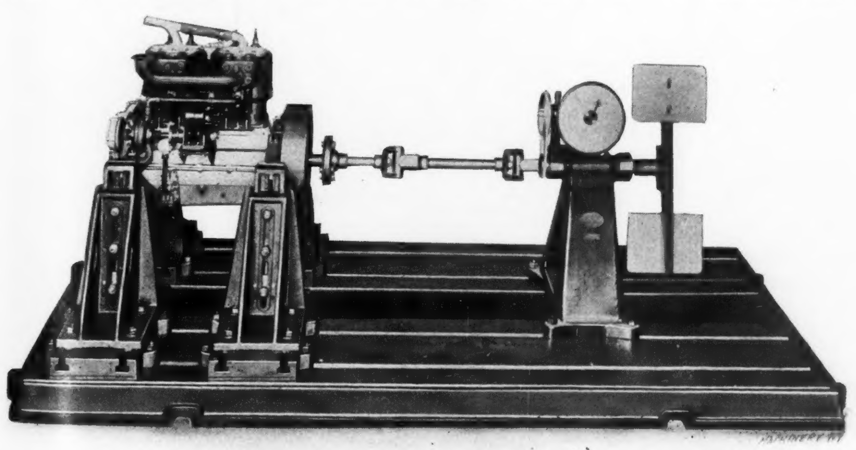
The table is constructed of hard wood with metal trimmings, and it is arranged to be easily "knocked down" for shipment. The electrical arrangement is such that the current for the motor may be obtained from any incandescent light socket by simple connections. A light-proof box for blueprint paper is attached to the end of the table, as shown. The top of the table is scored in inches and is provided with figures along the front edge, so that sheets can be instantly cut to any size. A sizing diagram can also be provided for the top of the table, which shows at a glance the size of any tracing or print and the square foot measurement, no calculation being necessary.

These tables are also furnished with a basket on the end, instead of a light-proof box, that is especially designed for prints after they have been run through an automatic continuous printing, washing and drying equipment. These tables, as regularly supplied, are 4 feet wide by 6 feet long, but any width up to and including 8 feet can be furnished. (They are also furnished in widths up to 42 inches, with a cutting knife arranged for operation by hand). The cutting machinery is all self-contained and it can be supplied separately if desired, so as to be bolted to any table of appropriate width. This table is the product of the C. F. Pease Co., 167 Adams St., Chicago, Ill.

TESTING BASE FOR GASOLINE MOTORS

The accompanying half-tone shows a testing outfit for gasoline engines that has been put on the market by Joseph Tracy, 116 West 39th St., New York. This outfit consists of a cast-iron bed-plate and universal supports for carrying the motor, which may be connected to a dynamometer or prony brake. As the engraving shows, the four supports for the motor are mounted on small base-plates which contain cross slots, thus permitting the supports to be adjusted laterally as well as longitudinally. A vertical adjustment is also provided by means of sliding members on the supports, which may be raised or lowered by suitable screws and locked by the bolts shown.

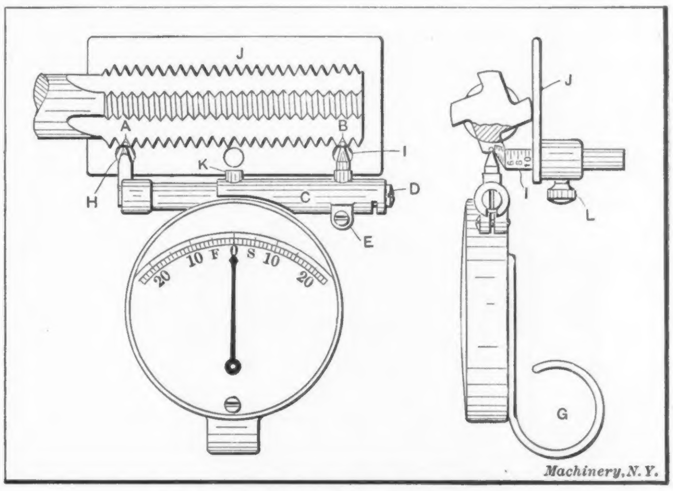
This bed-plate forms a substantial foundation for any motor-testing operations, and by means of the easily adjustable supports, any style or size of motor can be securely seated and lined up in a few minutes. The device has been designed to supply a reliable substitute for the make-shift methods usually employed for testing, which result often in a great waste of time in preparation for a test, and are often so unsubstantial that trouble is caused by the motor and dynamometer getting out of alignment while testing. All the contact surfaces of the bed-plate and motor supports are planed true.



Testing Base with Motor Supports having Universal Adjustment

THE WOLFE THREAD TEST INDICATOR

An indicator that is especially adapted for the rapid and accurate testing of threads on taps, dies, screws, etc., has been brought out by Joseph L. Wolfe, 859 Stratford Ave., Bridgeport, Conn. This indicator can be used for testing any tap or screw having a length of one inch or longer, and an inaccuracy of 0.0002 inch is said to be easily discernible. The dial of the indicator is graduated to read thousandths of an inch, and it has a range of 0.024 on either side of the zero mark. This instrument has two ball points, *A* and *B*, which are brought into contact with the thread to be tested. Point *A* is movable and point *B* is stationary. The latter can be unscrewed from its socket and screwed into the socket *K* when a testing range of 1 inch is desired. The sleeve *C*, which holds stationary ball point *B*, can be adjusted by screw *D*, the sleeve being held in its adjusted position by the clamp-screw *E*. The loop or handle *G* is used for holding the indicator when testing a thread.



Gage for Testing the Threads of Taps, etc.

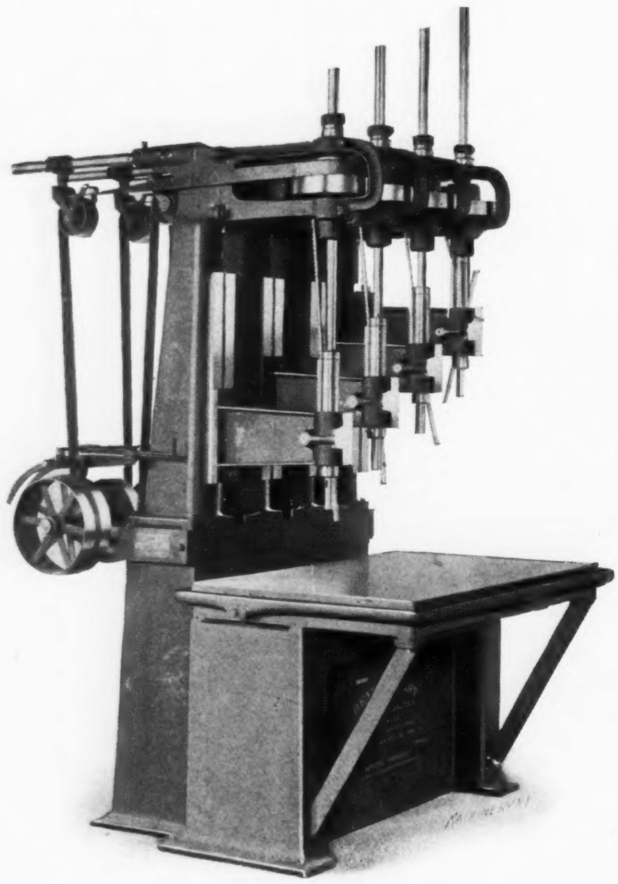
In addition to the indicator proper there is a centering gage which provides a means for enabling taps, screws, etc., to be tested on the center line, thereby insuring accuracy. This centering gage can be used on taper as well as straight taps, and it has a capacity for diameters ranging from ¼ to 1½ inch. The adjustable points *H* and *I* on the centering gage are graduated in thirty-seconds of an inch, and they may be held in any position by knurled thumb-screws *L*. As the engraving indicates, this centering gage also has a base-plate *J* against which the piece being tested is held. The engraving shows the gage being used for testing the threads of a tap, with the points *A* and *B* set to the two-inch range. When using the centering gage, the graduated points *H* and *I* are set out from the plate *J* a distance equal to the radius of the tap or screw that is to be tested. Knurled thumb screws *L* are than tightened, thus holding points *H* and *I* in the adjusted position. The tap or screw is next placed on the centering gage and held down on plate *J* and against the points *H* and *I*. The indicator itself is held in the hand with the thumb and first finger on opposite sides of the case, and with the second finger through the loop *G*. The indicator is then brought against the tap which is held on the centering gage with the other hand so that the stationary ball point *B* enters the thread and rests on the flat end of point *I*, and the movable point *A* also enters the thread and rests on the flat part of point *H*. The indicator will then show whether the thread is "fast" or "slow" in thousandths of an inch. If the thread is accurate, the pointer on the indicator will remain at zero. If it is "fast," the pointer will move in the direction of *F*; and if "slow" the pointer moves, of course, in the opposite direction.

HENRY & WRIGHT CABINET BASE DRILLING MACHINE

Another development in the line of high-speed ball bearing drilling machinery manufactured by The Henry & Wright Mfg. Co., of Hartford, Conn., is shown by the accompanying illustration. The table of this machine is not adjustable but it is firmly fastened to the cabinet base in a way that makes

it absolutely rigid and immovable in service. It may, however, be taken off if this should be necessary for redressing to renew its accuracy, by removing four bolts. The heavy design of drilling heads used in the automobile manufacturers' drilling machine described in the September number, are used on this type, and the combination is extremely rigid and unyielding.

The table is ribbed on the under side like a standard surface-plate and it is made extra heavy to provide for redressing. Four oil ducts fitted with strainers convey lubricant from the table to a tank inside the base. The machine will drive high-speed steel drills up to 1 1/8 inch in diameter, but its most



Henry & Wright Drilling Machine

efficient field of operation is the drilling of holes 7/8 inch in diameter and under; the extra power being intended to drill an occasional larger hole which may occur in a piece of work containing a number of smaller ones. This arrangement, of course, effects a considerable increase in the working range of the machine, as a large number of parts that would either have to be drilled, tapped, counterbored or reamed in two or more machines can frequently be done in one machine without removing the part from the jig, which tends toward greater interchangeability, accuracy and rapidity in manufacturing.

The hole in the spindle is a No. 2 Morse taper, so that it is necessary to reduce the taper of the largest drills in order to make them fit the spindle. The No. 4 machine, which is the size illustrated herewith, is the first one of this type to be produced, but it is the intention of the builders to make a wider variety ultimately. This machine will be furnished with a plain table or with full oiling equipment, including a tank, pump, piping, flexible tubing and faucets, as ordered. The No. 4 size weighs with an 8-inch overhang 3200 pounds; with a 12-inch overhang 3500 pounds; and with a 15-inch overhang 3800 pounds.

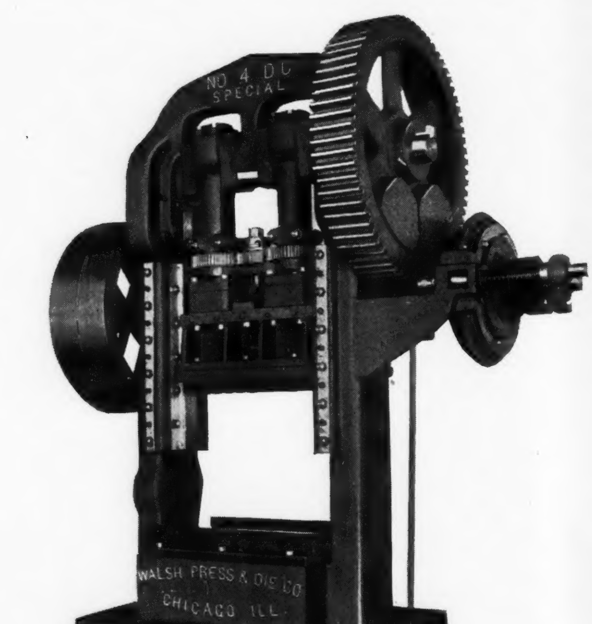
BESLY DISK WHEEL CEMENTING PRESS

Charles H. Besly & Co., Chicago, Ill., the well-known makers of disk grinders, have brought out an improved disk wheel cementing press, illustrated herewith. This press is so constructed that the top plate may be swung out of the way, as shown in the illustration, while the disk wheel is being glued, and swung back into position when pressure is to be applied. The press accommodates disk wheels 26 inches in diameter and smaller. The disk wheel is raised off the face of the press by a central shouldered shaft, which is actuated by a cam movement connected with the lever shown at the left. In raising, the cam is thrown slightly over the center and against a bumper-pin. This holds the disk suspended of its own weight. In lowering, the disk is raised slightly by means of the lever to permit the cam to come over the center, when it is lowered until the disk wheel rests on the pedestal casting. When pressure is to be applied, the yoke is swung into engagement with a stud set in the pedestal. No lock is necessary, as the pressure holds the yoke in position. The mechanical means for raising and lowering the disk is a desirable feature, as the large disk wheels are heavy and hard to handle, a 26-inch Besly disk wheel weighing 125 pounds.

Besly Disk Press

WALSH STRAIGHT-SIDED DOUBLE-CRANK PRESS

The accompanying illustration shows a special straight-sided double-crank press which is so designed that it will stop at any angle of its stroke by simply removing the foot from the foot-treadle, the latter controlling the transmission of power to the slide absolutely. This machine is driven by a friction clutch which is fitted with a brake-band on its rim. This clutch and the brake are clearly shown in the illustration.



Press built by the Walsh Press & Die Co.

When the treadle is compressed, the friction clutch engages and the brake-band is released. As soon as the treadle is released, the compression spring shown disengages the clutch, and the rod upon which the compression spring is mounted—being connected with the brake-band—compresses the latter which instantly stops the machine.

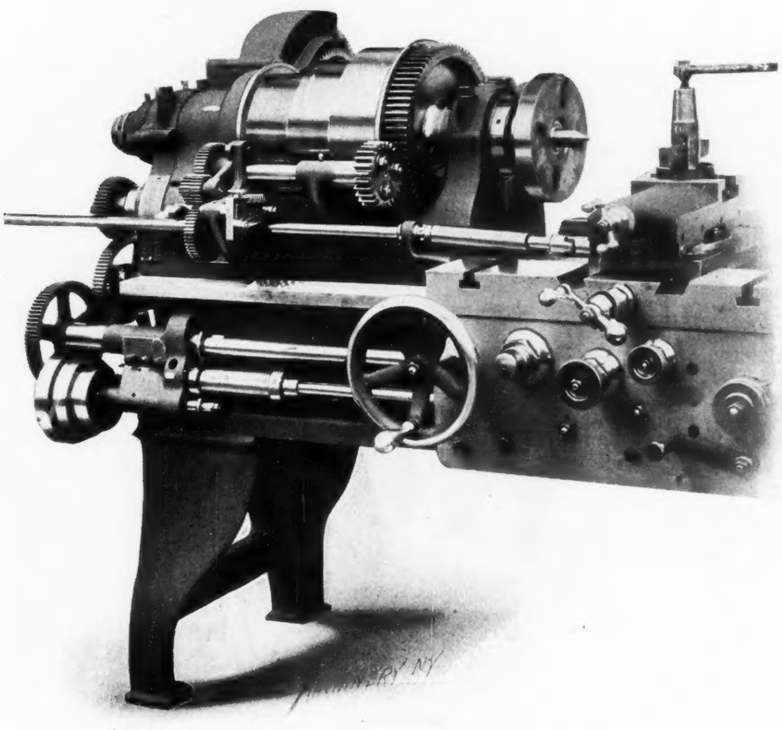
This press was designed by Mr. H. C. H. Walsh, and was built by the Walsh Press & Die Co., 4709-11 West Kinzie St., Chicago, Ill., to meet the requirements of a manufacturer who will use it in the production of horseshoe magnets.

BRADFORD RELIEVING ATTACHMENT

The relieving attachment here illustrated is made by the Bradford Machine Tool Co., Cincinnati, O., and it can be applied to this company's 14-, 16-, 18-, 18- heavy pattern, 20-, and 22-inch lathes or to other sizes if ordered. It may be used for backing off the teeth of reamers, taps, hobs, mills, etc., and it will relieve either straight or taper work having any number of flutes from 2 to 24, inclusive.

The attachment consists of a substantial bracket that is built as a unit with all the parts self-contained, thus insuring permanent alignment and smooth working of the parts. This bracket, with its mechanism, is mounted on the front of the headstock, as clearly shown in the illustration. This position is easily accessible, it being unnecessary to go to the rear of the lathe for making adjustments or for changing the gears.

As the illustration shows, the drive is from the face gear instead of the spindle gear. The advantage of this construction is that the attachment is speeded down and up in the same degree, thus avoiding abnormal gear ratios and small driven pinions or a multiplicity of gear centers to provide for the 2 to 24 movements per revolution of the spindle. This feature has heretofore been entirely overlooked and has resulted, on the one hand, in an exceedingly heavy and clumsy attachment, or, on the other hand, in an attachment unfit for the unnecessarily severe and excessive stresses imposed.



Lathe equipped with Bradford Relieving Attachment

A single fixed cam only is required and it is mounted on a shaft of large diameter and close to the shaft bearing, thus providing that rigidity which is so essential to a device of this kind. This cam actuates one arm of a lever through a roller on a tool-steel stud. The roller is fixed in position on the lever, and receives a true and correct movement at all times. In this attachment the amount of relief is obtained in the following manner: The derived motion of the roller is transmitted through the rocking lever and connecting-rod to a rock-shaft, which transmits the movement to the compound rest as will be explained later. One end of the connecting-rod is attached to a sliding block capable of adjustment towards and away from the center of the rocking lever. This adjustment controls the amount of motion to be transmitted to the rock shaft, and is obtained by means of a screw and knurled knob so placed that it is within easy reach of the operator. It is evident that the amount of relief is quickly and precisely adjusted from as fine to as coarse as may be required, and the whole range is at the operator's command without even stopping the lathe.

A bracket on the carriage carries one end of the rock-shaft, the movement of which is transmitted through a telescopic sleeve, shaft and knuckle joints, to a set of spur gears in the compound rest. On the side of one of these gears there is an eccentric hub which engages the bronze nut in the compound rest through which, in turn, passes the top slide screw. Now it is plain that the derived movement of the rock-shaft is transmitted through the telescopic sleeve, shaft, knuckles and eccentric gear and screw to the top slide of the compound rest, and it will be readily seen that a rocking movement will result in the compound rest top slide. A set of change gears and an index plate are furnished providing for from 2 to 24 such movements per revolution of the spindle.

The gear which meshes into the face gear, is adjustably fixed to a flange which is keyed to the shaft, thus providing an adjustment between the tool and the work when first setting up, without disconnecting.

The carriage of the lathe has full traverse between centers and the movements of the compound rest are always available. The attachment need not be removed when doing ordinary work, as simply locking the small quadrant up or down, respectively, disengages or engages the attachment. The practical value of this feature is readily apparent.

Superior 21-inch Upright Drill Press

The cam used in this attachment has the proper shape to give a uniform movement to the tool which is quickly withdrawn from the work by a strong spring capable of ready adjustment with nut and washer.

One of the novel features of this attachment is found in the connecting means between the connecting-rod and the rock-shaft, which facilitates the easy lengthwise movement of the rock-shaft even on coarse pitch taps, etc., and heavy cuts. The crank is fast to an inner sleeve and is driven by an outer bush. The sleeve drives the rock-shaft through a key, but is capable of an automatic limited movement lengthwise with the rock-shaft, independent of its driving connection, a strong spring returning it to the original position after each cut. This construction effectively overcomes any tendency of sticking or binding of the rock-shaft.

Gear guards are placed over all exposed gears and are arranged so that they can be readily removed when necessary.

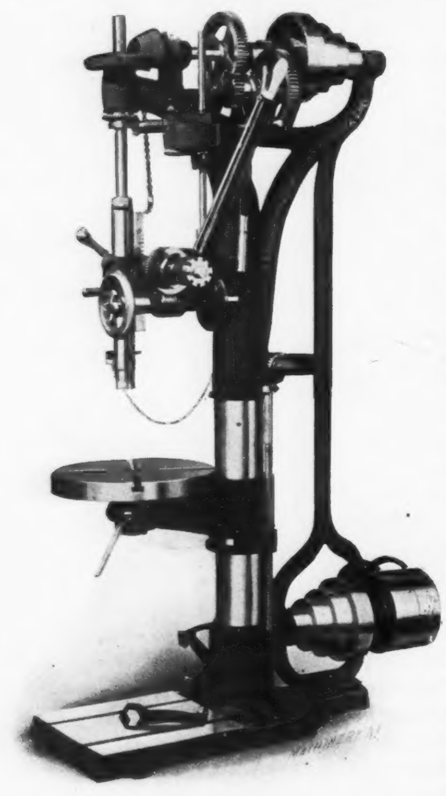
SUPERIOR 21-INCH UPRIGHT DRILL PRESS

The Superior Machine Tool Co., Kokomo, Ind., has brought out the design of upright drill press illustrated herewith. This machine, which is the 21-inch size, is built with back-

gears, positive geared feed and tapping attachment. The feeding mechanism is mounted on the head, which is stationary, and it is enclosed by a gear box. The drive to the feed mechanism is by a vertical shaft, which is driven from the spindle quill by spur gears. Four changes of feed are available, ranging from 0.006 to 0.016 inch per revolution of the spindle. These changes are effected by simply shifting conveniently located handles attached to the gear box. The tapping attachment, which was illustrated and described in the department of New Machinery and Tools for July, 1909, is equipped with friction gears which are enclosed with gear covers or guards. It will also be noted that the other gears are covered by suitable guards for the protection of the workman. This machine will drill to the center of a 21-inch circle. The maximum distances between the table and spindle and the base and spindle are 20 and 37 inches, respectively. The traverse of the spindle is 8 inches, while that of the table is 16 inches. The spindle is bored to receive a No. 3 Morse taper.

AURORA UPRIGHT DRILL PRESS

The design of drill press shown in the accompanying halftone has been brought out by the Aurora Tool Works, Aurora, Ind. This machine, which is of the stationary head type, is equipped with positive geared feed, the feed change mechanism being enclosed in a case attached to the column. Power is transmitted to the feed-box from the spindle driving quill through bevel gears and a horizontal shaft, and connection is made with the worm-shaft on the head by a vertical shaft and bevel gears as shown. The base is heavy and well-ribbed and the columns are of large diameter with the metal well distributed to insure strength. This machine, in common with the others built by this company, is provided with a back brace to avoid the possibility of springing the column. The yoke is made a part of the column to insure a substantial support for the top shaft, spindle, feed shaft and pulleys. The table arm has long bearings and it is carefully machined to fit the column. The table is also heavy, well ribbed and rests on a large circular bearing on the arm. All bevel gears are planed theoretically correct and run in babbitt metal bearings. If desired, this machine, which is built in 20- and 21-inch sizes, can be equipped with a tapping attachment.



Upright Drill Press built by the Aurora Tool Works

GRANT ADJUSTABLE TOOL-HOLDER

In Fig. 1 is shown an adjustable boring-tool holder that is intended for use principally on milling machines in connection with the boring of jigs, dies, etc. This tool-holder has a shank in which an adjustable slide carrying the boring tool is mounted. By turning the adjusting screw shown, the tool-carrying slide is positively moved in or out and the amount of movement is determined by graduations on the screw-head, which reads to thousandths of an inch. The slide has a movement of about 1 inch, and it is rigidly fitted in the head of the holder.

In Figs. 2 to 5 inclusive, some of the uses to which this tool may be put are shown. Fig. 2 shows it in position for boring bushing holes in a drill jig. These holes are first drilled slightly smaller than the required size, the drill being held by a chuck in the milling machine spindle. After the hole is drilled, the boring tool is put in the spindle of the machine and is used to bore the holes to the required size. The spacing between the centers of the holes can be read directly from the feed-screw dials or from verniers when the machine is so equipped.

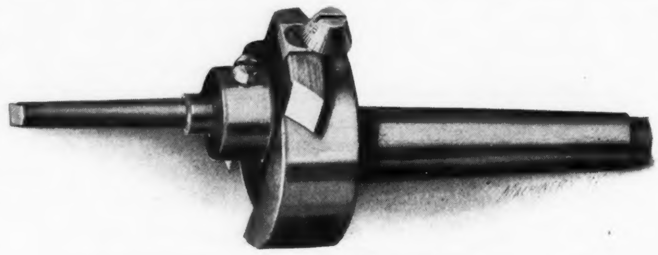
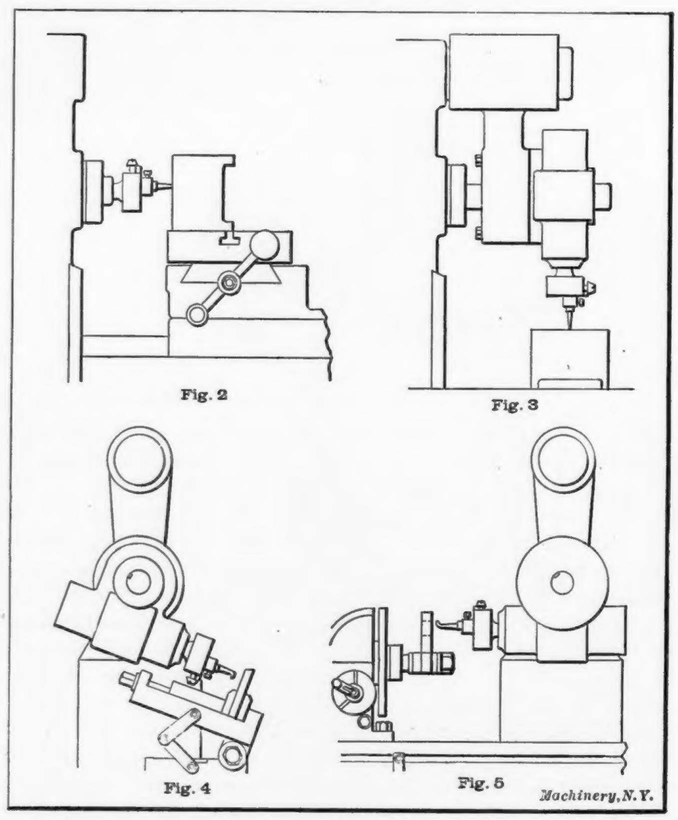


Fig. 1. Adjustable Boring-tool Holder for Milling Machine Work

In Fig. 3 the tool is shown held in a vertical attachment and at work on the top of a jig. In Fig. 4 it is being used for generating a form tool. The tool blank, after being roughed out, is held in a universal vise that is inclined to an angle of about 22 degrees to give the proper clearance. The vertical attachment is set to the same angle, so that the point of the tool, while revolving, describes circles in planes parallel to the face of the tool blank. The tool is then fed through the blank by moving the platen longitudinally.

In Fig. 5 the method of using the tool on work mounted in the dividing head is shown. Jigs, the bushing holes of which have a circular lay-out, can be bored to advantage in this manner by clamping them to the faceplate of the dividing head.



Figs. 2 to 5. Examples of Work done with Grant Adjustable Holder

The foregoing show a few of the uses to which this tool may be put and are given as examples of its adaptability to general tool-room and machine shop work. The particular tool-holder shown in the illustration is fitted with a No. 7 Brown & Sharpe taper shank, and it is adapted for boring all sizes of holes up to 2 inches in diameter. Larger and smaller sized holders with shanks of any required taper may also be obtained. A smaller size, having a No. 4 Brown & Sharpe taper shank is recommended as the most economical for small jig

work and should be used in connection with a high speed attachment. It is adapted for boring holes up to one-half inch in diameter. This tool-holder is made by the Grant Mfg. & Machine Co., 80 Silliman Ave., Bridgeport, Conn.

MASSILLON STEAM HAMMER

The 1500-pound steam hammer shown in Fig. 1 represents the latest type of hammer manufactured by the Massillon Foundry & Machine Co., of Massillon, O.

In building single-frame hammers some makers use two bolts which pass through the main frame and into the slides, and depend upon these bolts, together with the thin and narrow wedges often used, to hold and back up the slides and guides. Other manufacturers eliminate the bolts entirely and place their slides and guides in a cavity which is provided in the cheek of the main frame, with adjusting bolts passing from the outside of the frame cheeks into the back of the slides and guides. In the construction of the hammer shown in Fig. 1, both of these ideas are employed: Two bolts pass through each slide and back through the main frame, thus throwing the strains of the ram back onto the frame of the hammer where they belong, rather than on the cheeks. This construction is clearly shown in the sectional view Fig. 2. This illustration also shows the swell or enlargement of the main frame which extends back of and partly to the front of the wedges and slides, thus forming a pocket or a partial cavity into which the slides and wedges fit. The advantageous feature of this construction is that the cheeks of the main frame behind the slides, back up and support the bolts which pass through the main frame, while, on the other hand, the use of the bolts passing through the main frame, supports and protects the cheeks on the frame casting. The result is a construction which is practically unbreakable.

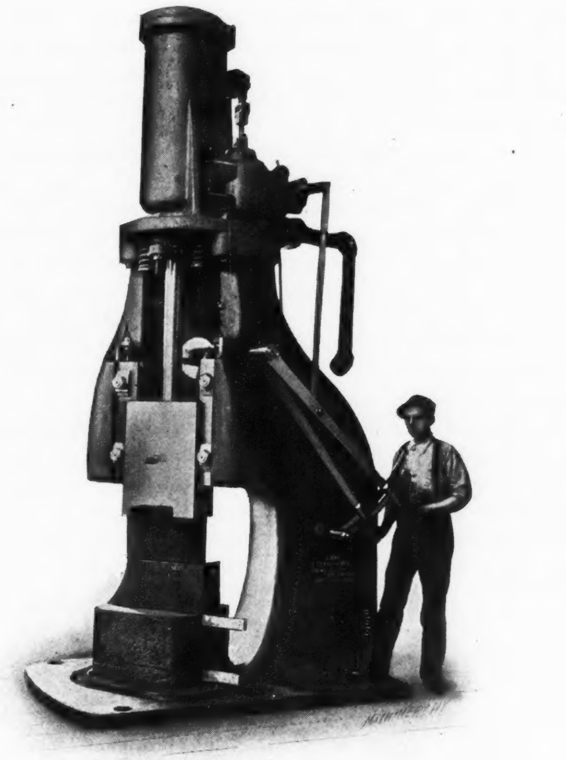


Fig. 1. Massillon 1500-pound Steam Hammer

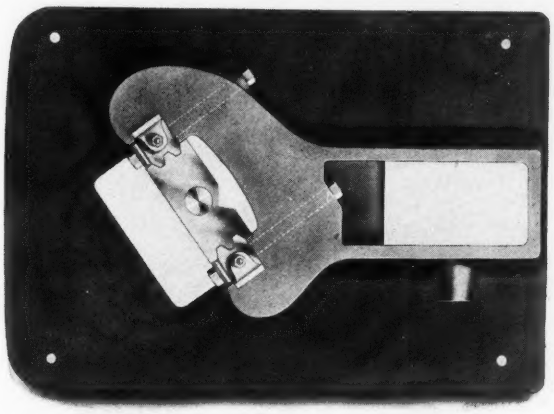


Fig. 2. Sectional View showing Construction of Guides

The slide wedges used in this hammer are made of the best quality of forged steel, and they extend the full width of the base or back of the slides. The cheeks of the main frame furnish a strong base or bearing for these parts. The construction is further strengthened by projections on the cheeks which extend out beyond the wedges and cover part of the front side of the slides, thus making a pocket or cavity for the latter.

Fig. 3. Section through Lower Part of Column

Fig. 3 further illustrates the construction of the main frame, showing in particular the thickness of the metal in the frame casting behind the ram at a point where strength is most needed. By this plan all lugs or ribs have been eliminated. This hammer has recently been patented, the claim allowed covering the construction of the main frame at that point where the slides and wedges are located.

LA SALLE NO. 4 SINGLE-ACTION OPEN-BACK POWER PRESS

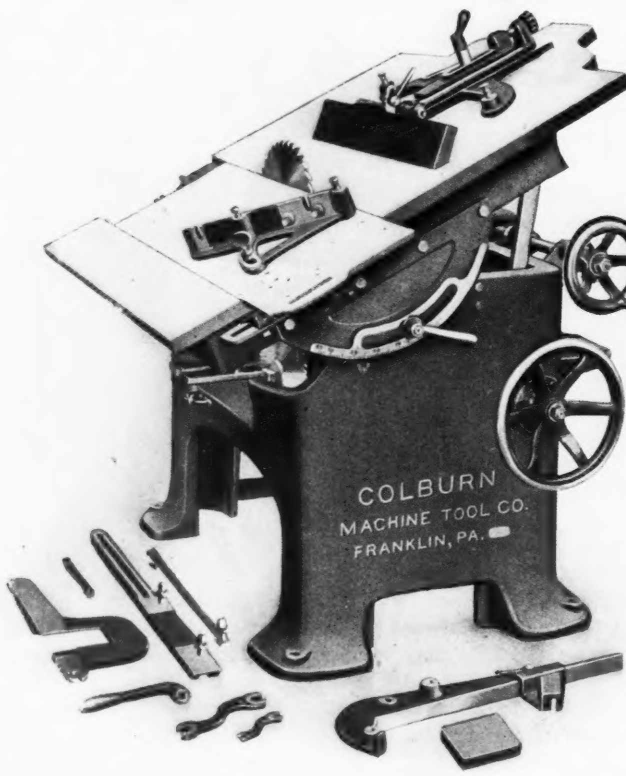
The power press shown in the accompanying halftone is the product of the La Salle Machine & Tool Co., La Salle, Ill. In the construction of this machine, no radical departure has been made from former designs, the aim of the manufacturers having been to produce a well built and rigid tool. The adjustment of the slide is by means of a sleeve connection which is made by fitting a large steel nut, or internally threaded sleeve, to the lower member of the connection, and connecting the upper and lower members by a right- and left-hand screw. This screw is turned by means of a collar through which the screw is fitted. The adjusting screw and collar are casehardened. This makes a very strong adjustment and one that will not loosen from shock or strain of the press. An adjustable brake is provided to prevent the press from running over when the clutch is released. The members of the clutch are made of hardened tool steel, and the sliding dog which engages the flywheel, strikes on a hardened steel plug inserted

La Salle Open-back Press

in the slot of the flywheel, thus preventing excessive wear. The flywheel is bushed with phosphor-bronze and all bearings are scraped and are adjustable for wear.

COLBURN UNIVERSAL SAW-TABLE

An improved design of universal saw-table for pattern shops and other wood-working establishments, has been brought out by the Colburn Machine Tool Co., Franklin, Pa. A number of



Colburn Universal Saw-table and Attachments

improvements are incorporated in the design of this tool, among which may be mentioned the mechanical tilting device for the main table, the micrometer adjusting splitting fence, and the extension to the table which allows wider stock to be cut.

The column or main frame is a one-piece, heavily-ribbed casting that is symmetrical in design and has a large arched opening on the side to allow the inner mechanism to be easily inspected. The table, which is 42 inches long by 40 inches wide, is divided into three sections, namely, the main table located at the right of the saw, the sliding table, and the shelf or section at the left of the sliding table. One of the important advantages of this construction is that the sliding table may be quickly and easily operated as it is but 12 inches wide and does not have the weight of the wider and more cumbersome tables. It is mounted on dustproof roller bearings and travels in carefully scraped and fitted trackways for which proper lubrication is provided. These ways are located in an intermediate track which is adapted to move toward or away from the saw, thus giving ample room for dado heads up to 2 inches wide. The outer portion of this track is extended out to the left and upward, level with the sliding table, thus making a shelf for the support of long work. The entire table can be tilted through the various angles up to 45 degrees, by means of a handwheel which operates a cut-steel pinion that meshes with a steel rack. This mechanism gives a quick adjustment, and as the table is balanced, the handwheel is turned with little effort. The angle to which the table is set is shown by a pointer and graduations on the side of the column.

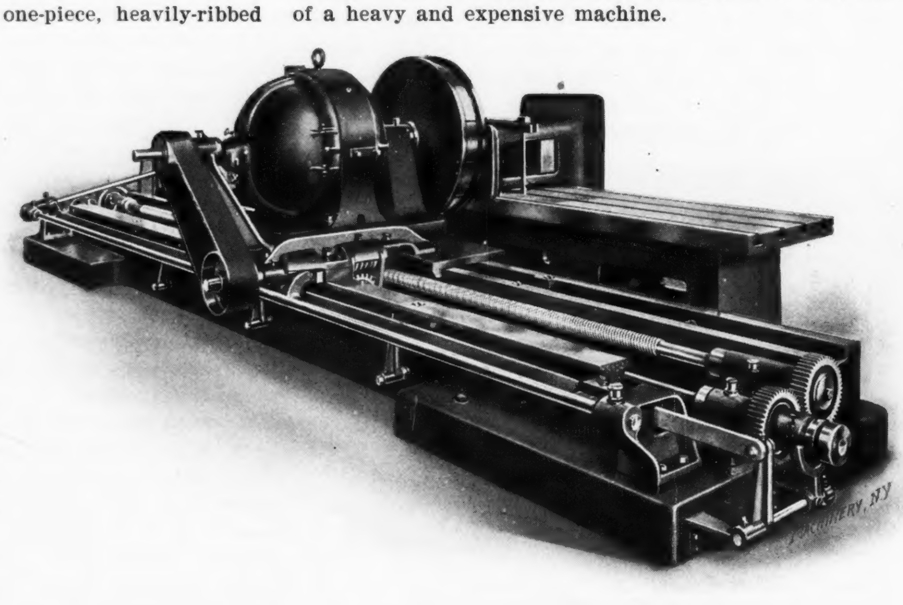
The ripping gage of this machine may be set to rip stock up to 21 inches in width, and it may be used either on the stationary or sliding table. When ripping is to be done with the table tilted, the gage is always placed on the left-hand or lower side, as the stock then has a firm support and heavy material is held by its own weight against the gage. When sawing out core-boxes or other hollows, the gage may be set diagonally to the saw. This gage tilts to an angle of 45 degrees with the table and it is provided with a small square block which may be attached to its face and used as a gage for cutting off short pieces. The use of this block prevents the pieces from wedging between the saw and the gage after they are severed.

The cutting-off gage may be set on the sliding table in two positions, one being for wide work and the other for average widths. This gage can be instantly set for cutting triangles, miters, hexagons and octagons. It is accurately located for these different uses by ground taper pins, which engage with carefully reamed holes in the table. Any intermediate angle may also be obtained by clamping the gage in position with a thumb-screw. An auxiliary cutting-off gage is furnished, which is provided with end stops and allows work up to 60 inches in length to be cut off.

The regular equipment furnished with this machine consists of a countershaft; two 14-inch saws (one rip and one crosscut); one splitting fence; one cutting-off gage; one auxiliary cutting-off gage for cutting stock to exact length from 1 inch to 50 inches; one extension cutting-off gage for finished moldings and similar work; one cut-off gage block for short pieces; taper pins; thumb-screws, and a complete set of wrenches.

TRAVELING HEAD FACE GRINDER

This machine was designed by its builders, the Diamond Machine Co., Providence, R. I., for the heavy grinding of work having such a shape or size as to make it more advantageous to move the wheel-head than the work, and it is especially fitted for grinding the ends of long pieces, such as cast-iron building columns, built-up steel columns, etc. This grinder is also used for grinding heavy parts, of various shapes, the finishing of which would otherwise be impossible without the use of a heavy and expensive machine.



Rear View of Diamond Traveling Head Face Grinder

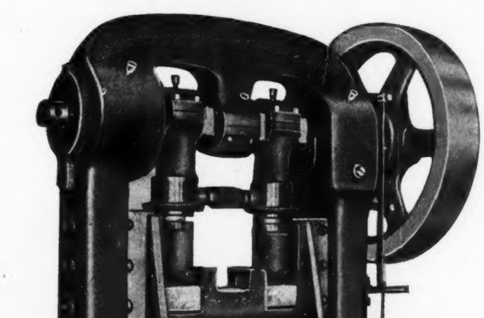
The grinder has a massive table cast in box form, which will support the heaviest work without distortion. The grinding wheel furnished with the machine can be of any abrasive desired. It is held in an adjustable chuck which precludes any possibility of its bursting, and at the same time allows the wheel to be fed forward in the chuck, thus getting the maximum amount of wear from it. The motor is mounted

upon the grinding wheel spindle and has sufficient power for the heaviest work. The front bearing of the wheel-spindle is a ring-oiling bronze held in a massive support that is cast solid with the traveling head. The longitudinal feed of the wheel-head is obtained from the rear end of the wheel-spindle through a belt and gearing, as shown in the engraving; the belt acts as a safety clutch, and slips in case the wheel is brought up against any obstruction. The automatic feed of the wheel to and from the work is obtained from the same source. The longitudinal feed is automatic, its direction being changed either automatically or by a hand-lever conveniently placed. The operator has all necessary control from one position. In the design of this machine the details have been carefully considered. A liberal means of oiling all bearings, both cylindrical and sliding, has been provided. All gears are cut and are of suitable material for the work required.

The principal dimensions of this grinder are as follows: Total travel of head, 144 inches; cross-feed of head, 4 inches; length of slide bearings, 60 inches; size of table, 25 by 144 inches; height of table from floor, 24 inches; length of main ways, 216 inches; distance across the ways, 32 inches; height to center of spindle, 34 inches; length of spindle bearings, 10 inches; and diameter of spindle in the bearings, $3\frac{1}{2}$ inches. The table length can be changed to suit individual requirements.

STANDARD DOUBLE-CRANK PRESS

The double-crank press illustrated herewith is a modification of the regular line of "J" presses built by the Standard Machinery Co., 7 Beverly St., Providence, R. I. This machine is fitted with an instantaneous Horton roller friction clutch



Standard Machinery Co.'s Double-crank Press

that permits less than 1/32 inch travel of the periphery of the wheel after it is engaged. The driving wheel on the plain press is 60 inches in diameter and weighs a ton in the rim, whereas on the back-geared press it is 42 inches in diameter and weighs 1400 pounds. The slide of the machine is made extra wide to accommodate blanking dies of a large area. The thrust blocks in the ram are of bronze and the connections are of high-grade iron and steel. Both connections are adjusted simultaneously by turning the squared shaft down with a wrench, the movement being imparted to the adjusting screws through bevel gears. This method makes it comparatively easy to adjust the ram. The ram without any attachments, weighs 1000 pounds and with boxes, lower connection, attachments, etc., it will weigh between 1800 and 2200 pounds. Notwithstanding this weight, however, it can be adjusted with comparative ease by using a 14-inch wrench.

The dimensions of this machine, which is made in both geared and plain types, are as follows: Distance between uprights, 44 inches; length of bed front to back, 28 inches, right to left, 52 inches; distance from ram to bed (stroke down), 13 inches; length of stroke, 3 inches; adjustment, $2\frac{1}{2}$ inches; over-all height of machine, 112 inches; and floor space, 60 by 75 inches.

ROBEY-SMITH BEVEL GEAR PLANER

The accompanying halftone shows the Robey-Smith automatic bevel gear planer. This machine is an improved de-

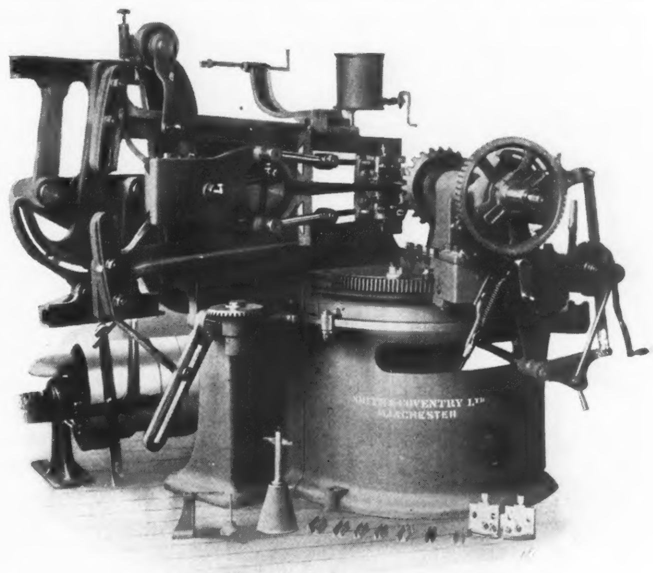


Fig. 1. Robey-Smith Bevel Gear Planer with Improved Indexing Mechanism

sign, the American rights for which have recently been acquired by Schuchardt & Schütte, Cedar and West Sts., New York. In the old model, the operation of the machine was accompanied by considerable noise in connection with the indexing mechanism, the movement of which was effected by a cam and a number of levers. In the new model, these levers have been replaced by a positive chain drive, which has overcome the objectionable feature mentioned. This chain, which is located at the rear, transmits power from the driving cone to a sprocket which is secured to a shaft that runs through the base to the front of the machine. This shaft, which is offset to an angle of 12 degrees by means of a universal joint, transmits motion to a pair of bevel gears. To one of these gears is secured the link motion operating the pawl that advances the indexing plate on the spindle carrying the gear blank.

In the operation of this machine, two planing tools are used, one on each side of the tooth. These tools are attached to slides that are mounted on pivoted arms which converge on a center intersecting the apex of the pitch cone of the blank being cut. The tools move backwards and forwards on the pivoted arms, and, at the same time these arms are gradually opened and closed so that the distance between the tools is varied and curves are formed on the teeth being cut. The saddle carrying the blank to be cut has a rotary motion about a center that is directly under the apex of the pitch cone of the blank, and it is this rotary motion which feeds the blank

Fig. 2. Gear-cutting Operation performed in Robey-Smith Machine

to the tools, the movement being automatically stopped when the proper tooth depth has been cut. As the illustration shows, the saddle is connected with the pivoted arms carrying the slides and cutting tools, by a circular bar having teeth cut in it at one end. Meshing with these teeth there is a quadrant, which, through a pair of bevel gears, a slotted

lever and a connecting-rod, controls the swinging parallel motion which, in turn, controls the pivoted arms. The blank is rotated a distance equal to the pitch for each stroke of the tools. See MACHINERY, August, 1908.

In Fig. 2, a gear-cutting operation that is performed on this machine, and one that will doubtless interest automobile manufacturers, is shown. The piece illustrated is a gas engine cam-shaft, and the bevel gear seen near the flanged end forms an integral part of the shaft. When cutting the teeth of the gear, the flanged end is held by a chuck in the work-spindle, and the outer end is supported by a rest. The advantage in having the gear integral with its shaft is, of course, obvious. The equipment furnished with this machine includes three gages for setting the tools and one for setting the blanks in position; eight pairs of high-speed steel cutting tools; complete overhead driving apparatus, and the necessary wrenches.

BANTAM BALL-BEARING PILLOW-BLOCK

A type of ball-bearing pillow-block that is manufactured by the Bantam Anti-Friction Co., Bantam, Conn., is shown in Figs. 1 and 2. These bearings are intended for excessive or high speeds. Fig. 1 shows the bearing assembled, while Fig. 2 is a view of it partially disarranged, the plates being removed so as to show the ball races, method of oiling, and the clamping arrangement of the inner spool. This clamping is effected by a conical sleeve that is fitted to the tapering bore of the inner race. The shaft passes through the bore of this sleeve and the latter, which is split to allow the necessary contraction, is tightened on this shaft by being drawn into the inner race by a collar that is screwed on the threaded end of the sleeve and against the race. This simple method of clamping the inner race—known as the "adapter" method—makes it possible to quickly attach or remove one of these bearings from its shaft.

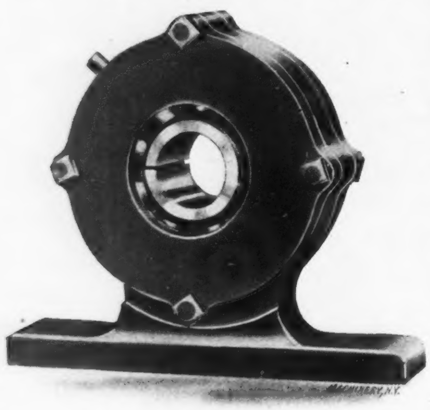


Fig. 1. Ball-bearing Pillow-block for High Speeds

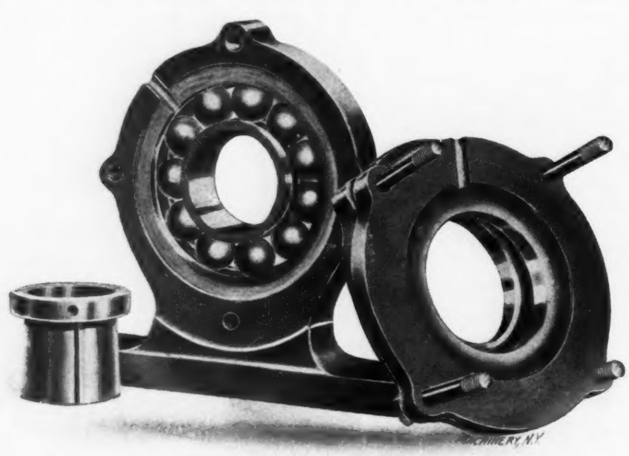
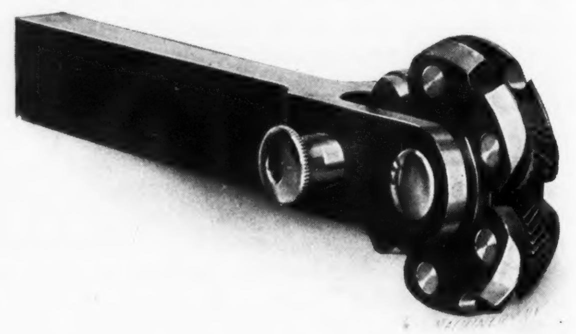


Fig. 2. Pillow-block with Side Plates removed

This type of bearing has been employed with successful results in connection with hat machinery and similar lines. The races are not made of so called "tool steels," but of high-grade close-fiber machinery steels, that are carefully and well casehardened.

MILLER TOOL CO.'S KNURLING TOOL

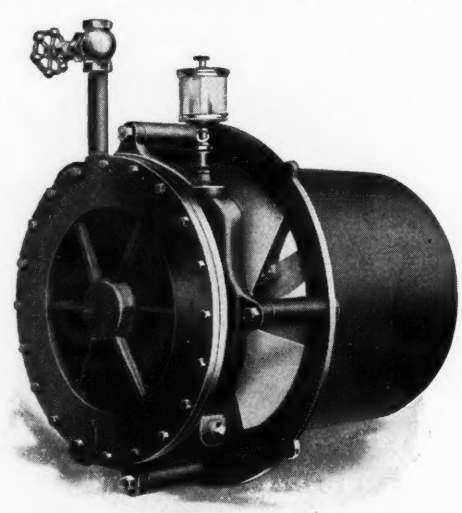
The knurling tool shown herewith is known as the "six-in-one," the name being derived from the fact that there are six knurls available that may be used either in pairs or singly. The knurls are arranged in pairs of the same pitch, so that three grades of cross and a similar number of single knurls may be obtained. When a single knurl is being used, the screw shown at the side of the tool is used for locking the turret. The knurls are all machine-cut, and they are mounted on hardened pins of tool steel. The holder and turret are of pack-hardened machine steel, and all working parts are accurate and true. This tool is suitable for use on engine lathes, turret lathes and screw machines and for both heavy and light work. It is made by the Miller Tool Co., New Britain, Conn.



Knurling Tool with Three Sets of Knurls

STURTEVANT TURBO-UNDERGRATE BLOWER

The B. F. Sturtevant Co., Hyde Park, Mass., has recently placed on the market a compact design of turbo-undergrate forced draft set that is intended particularly for electric power plants that need increased draft during the peak of the load, and for plants that have outgrown their stack capacity, heating systems, etc.



Blower with Propeller-type Fan driven by Direct-connected Turbine

The construction of this blower set is simple and durable. It consists of a single-stage impulse steam turbine that is direct connected to a propeller-type fan. The bucket wheel of the turbine is a solid steel forging carefully machined, the steam buckets being milled in the periphery of the bucket wheel. The steam nozzles are made of Tobin bronze and they are held in place by composition draw-up nuts. The construction of the steam case gives accessibility to the steam nozzles for inserting, removing or cleaning them.

An ample dust-proof phosphor-bronze bearing and thrust washers are provided with oil cup lubrication. The bearing is so constructed that it can be renewed at a small cost.

The fan is built up and consists of six polished sheet aluminum blades rigidly fastened with hard drawn copper rivets into a bronze hub, which is finished all over to secure the proper balance necessary for the high rotative speed of these sets. The materials used in the construction of the fan insure mechanical strength and also corrosive resisting power. The stationary members of the blower set are constructed of cast-iron parts of ample strength and rigidity.

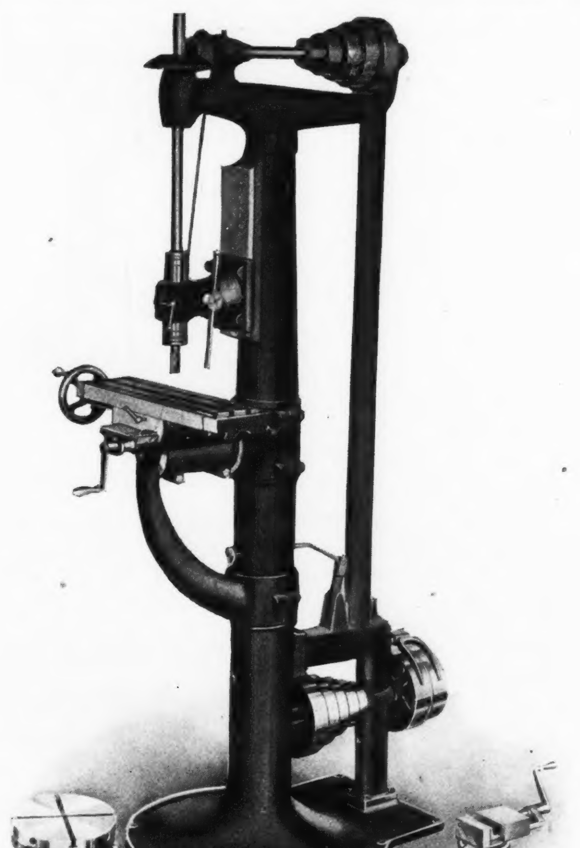
This blower is practically silent in operation, and it requires a minimum amount of attention as it can be controlled by a hand damper regulation or by regulating valves operated by the boiler steam pressure.

As the exhaust steam from the turbine contains no oil, it may be used to advantage for any work to which exhaust steam may be put, as in feed-water heaters, heating, etc.

KNIGHT NO. 1 DRILLING AND MILLING MACHINE

The W. B. Knight Machinery Co., 2019-25 Lucas Ave., St. Louis, Mo., has just placed upon the market the improved type of combined drilling and milling machine shown in the accompanying engraving. This machine is said to have nearly three times the cutting power of the No. 1 size formerly manufactured by this company, and it is much more rigid in its construction. Among the changes may be mentioned the improved form of drive, the addition of a back-supporting brace to the column, and a different design of table-supporting arm.

This machine is designed for performing a variety of both drill press and vertical miller work. The table is so mounted on its supporting bracket that it may be tilted to any desired angle, and its angular position is indicated by suitable graduations. It may also be swung about the column and it is provided with longitudinal and cross-feed movements. Both



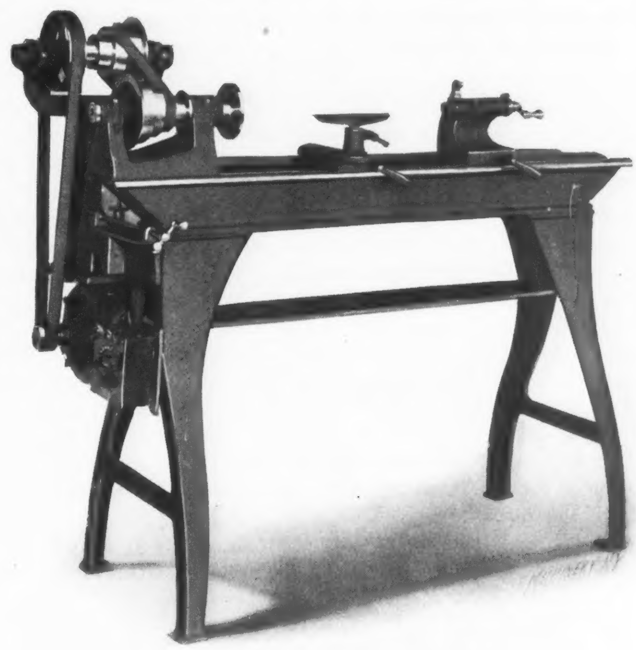
Combination Drilling and Milling Machine

feed-screws are equipped with graduated set collars, which may be used to advantage for laying out accurate work.

A drill plate is furnished with the machine, which may be bolted on the slotted table and used for plain drilling. The circular attachment shown at the left of the base, will be found useful for milling out dies, cams, and circular pieces having special shapes, the latter being accomplished by using special cutters. The equipment also includes a swivel graduated vise, a chuck, and a drill guide. The latter attachment, which is seen in front of the base, is fastened when in use, to the column just below the sliding head, and the projecting arm is used to steady the drill which passes through it. This device may be employed to advantage when laying off and drilling holes in dies, jigs, templets, or for other work where accuracy as to the distance between the holes is required. It is also useful for drilling holes in a surface which is not at right angles with the drill, as the guide prevents the latter from running to one side. These attachments, together with the universal adjustment of the table, adapt the machine to a large variety of work.

MOTOR DRIVE FOR SENECA FALLS SPEED AND WOOD-TURNING LATHES

In the accompanying engraving is shown an electric motor drive for 10-inch speed and wood-turning lathes as applied by



Wood-turning Lathe with Motor Drive

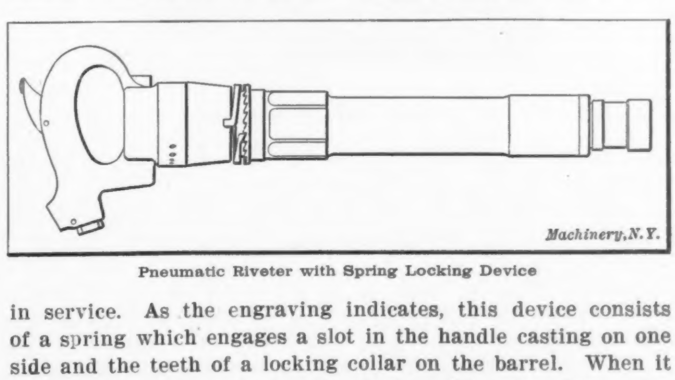
The Seneca Falls Mfg. Co., 330 Water St., Seneca Falls, N. Y. It is similar to the motor drive this company has been using for some time on their screw-cutting engine lathes.

The upright countershaft frame is hinged on a bracket that is attached to a leg; and the cone belt is tightened by turning the hand-crank shown on the bracket. The belt from the motor is tightened by a hand nut, and both belts can be kept at the proper tension without shortening them, until worn out. The bearings of the countershaft have oil rings the same as the head spindle bearings of the lathe.

An important advantage of this type of drive is that any constant-speed motor may be used, and preferably a small motor 1/2 or 3/4 horsepower of high speed, as they cost less than slower speed motors. Many motor-drive attachments are confined to one or two kinds of motors and therefore cannot be used on all kinds of current. Variable-speed motors can be used if desired, and will be found desirable on some classes of work.

MONARCH PNEUMATIC RIVETER

The Monarch pneumatic riveter manufactured by the Standard Railway Equipment Co., of St. Louis, Mo., has been fitted with an improved self-tightening spring-locking device which makes it impossible for the barrel and handle to become loose



Pneumatic Riveter with Spring Locking Device

in service. As the engraving indicates, this device consists of a spring which engages a slot in the handle casting on one side and the teeth of a locking collar on the barrel. When it is desired to remove the handle, the barrel is gripped in a vise

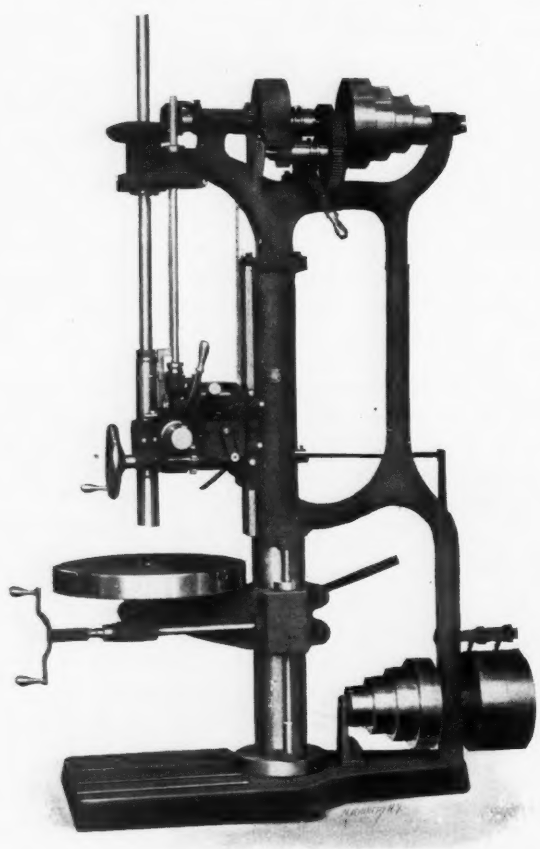
with the handle up and the tooth part of the spring is then disengaged from the collar by means of a screw-driver or small chisel. In order to keep the spring from engaging the collar teeth while unscrewing the handle, a piece of sheet metal should be placed between the spring and the collar for the former to slide upon. A bar is then placed through the grip hole of the handle which is unscrewed the same as an ordinary nut.

The riveter itself is simple in construction and high-grade materials are used throughout. The barrel is made of special vanadium steel, and the valves, valve-block and piston are of tool steel. These hammers are fitted with a safety device when specially ordered to prevent the accidental shooting out of the piston or rivet set.

KERN IMPROVED UPRIGHT DRILLING MACHINE

The machine illustrated herewith is one of the new line of standard upright drills built by the Kern Machine Tool Co., Cincinnati, O., for general manufacturing purposes. The principal improvement in this machine over this company's standard construction is in the effective device used to obtain the eight positive feeds furnished with this line. As will be noted, the feed box is placed on the sliding head, utilizing the space back of the quick approach and return lever. When located at this point, it does not interfere with the full traverse of the sliding-head in either direction and permits the box to be of sufficient size to allow the feed gears and shafts to be of ample size and coarse pitch. This gives an easy torque to the shafts with a consequent high efficiency and long life to the mechanism.

The feeds provided range from 0.006 to 0.048 inch per revolution of the spindle. All changes are made without stopping the machine, and the principle embodied in the box is the well approved tumbler and sliding-gear design.



Kern Upright Drilling Machine

Another feature worthy of mention is the improved automatic trip to the feed mechanism. This is located directly on the feed shaft in the form of a saw-tooth clutch, and is operated either by hand or by a suitable trip-dog located on the sleeve rack, and adjustable to any depth within the range of the spindle. This does away with the gravity or drop worm box, and permits a constant full contact between the worm and worm-wheel at all times. A suitable "shearing-pin" is placed in the feed shaft to protect the feed box against accidents. The machine is fully gear-guarded, and has eight changes of speed. It drills to the center of a 25-inch circle and has a spindle traverse of 9¼ inches. The spindle is bored to receive a No. 4 Morse taper. The back gears have a ratio of 6.5 to 1, and a bevel gear ratio of 2¼ to 1. The traverse of the sliding head is 17 inches, and the traverse of the table arm on the column, 15 inches. The net weight of the machine is 1600 pounds.

GREENERD EXTRA-CAPACITY ARBOR PRESS

A new design of arbor press has just been brought out by Edwin E. Bartlett, 326 A St., Boston, Mass. These presses are to be built in three sizes, known as Nos. 13, 14 and 15. They will correspond in power to the Ncs. 3, 4 and 5 Greenerd presses, but the capacity for diameters is increased, the No. 13 press taking 30 inches, while the two larger sizes have a capacity for diameters up to 36 inches. The distance over the plate can be easily increased by making the side-rods longer. As the accompanying illustration of the smallest, or No. 13 size, shows, these extra-capacity presses are mounted upon wheels which makes it easy to move them about the shop—an advantage which many will appreciate. In connection with the forcing mechanism, there is a ratchet and pawl which makes it always possible to use the lever in the most efficient position, the ratchet being keyed fast to the pinion while the pawl is held in the casting through which the lever passes. The lever is counterbalanced, as shown, so that it will automatically come to a vertical position; the pawl is then disengaged and the ram is free to be moved by means of the handwheel shown. The lever is free to slide in its casting so that the leverage employed can be varied as more or less power is required, there being an advantage, of course, in shortening the lever for light work. A soft metal bottom pocket for retaining the arbors or mandrels is provided, and is a feature which experience has proved to be advantageous.

Greenerd Arbor Press

FARWELL GEAR TESTER

The Farwell gear-testing machine shown in Figs. 1 and 2 has been designed by the Adams Co., 714 White St., Dubuque, Iowa, for testing spur gears ranging in size up to 30 inches between centers. Any inaccuracy in the diameter or depth of the teeth is shown by this device, and skew teeth or gears cut eccentric with the bore may be detected. The clearance and the running of a pair of gears on correct center distances may also be tested.

Mounted on the cross-rail of this gear tester, there are two heads—one stationary and one movable—in which are inserted the arbors that hold the gears while they are being tested. The sliding head is moved and set by means of a screw, and a ratchet relief is provided in the crank handle as a safety device to prevent injury to parts by the careless jamming of the gage or gears.

The screw controlling the movement of the sliding head is cut with great care and accuracy, and a 12-inch adjustable micrometer gage is furnished for checking up the setting of

the micrometer disk on the end of the screw. When using the 12-inch gage for checking the adjustment, it is set to 11½ inches when one-half-inch arbors are used, or to 11 inches when 1-inch arbors are employed. The top of the upper rail has a scale graduated to read in inches and tenths of an inch. The finer measurements are obtained from the large mi-

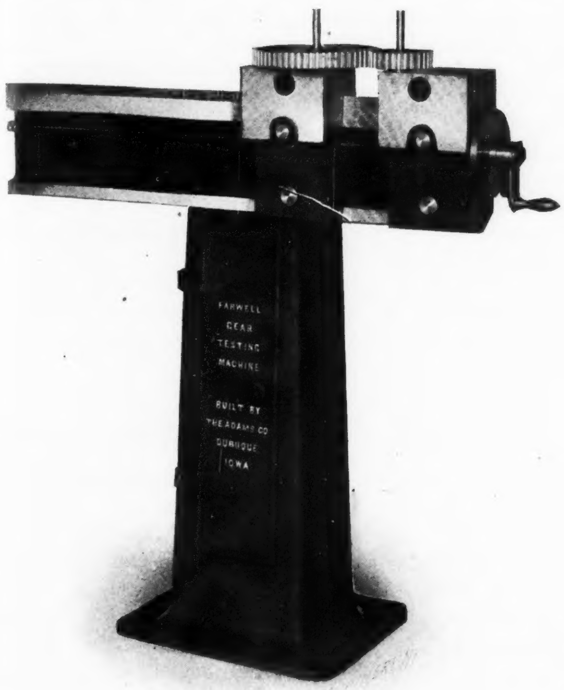


Fig. 1. Farwell Gear Testing Machine

crometer disk at the right end of the screw, which is graduated to read in thousandths, while a block on the head gives readings of quarter thousandths. This micrometer disk is more clearly shown in the detailed view, Fig. 2.

The screw for moving the outer head is supported in the stationary head by a series of collars having angular sides that run—as does the Acme-threaded screw—in split babbitt nuts. The lower thumb-nut in the heads enables the nuts on the screw and collars to be kept as tight and free from lost motion as is consistent with the free working of the screw. A gib,

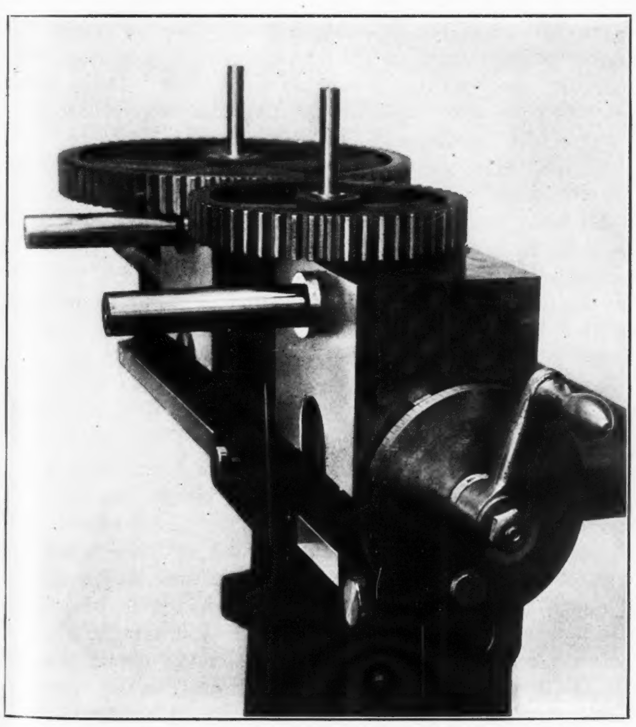


Fig. 2. Detail View of Gear Tester showing Gears on the Vertical Arbors, and Micrometer Disk for Fine Measurements

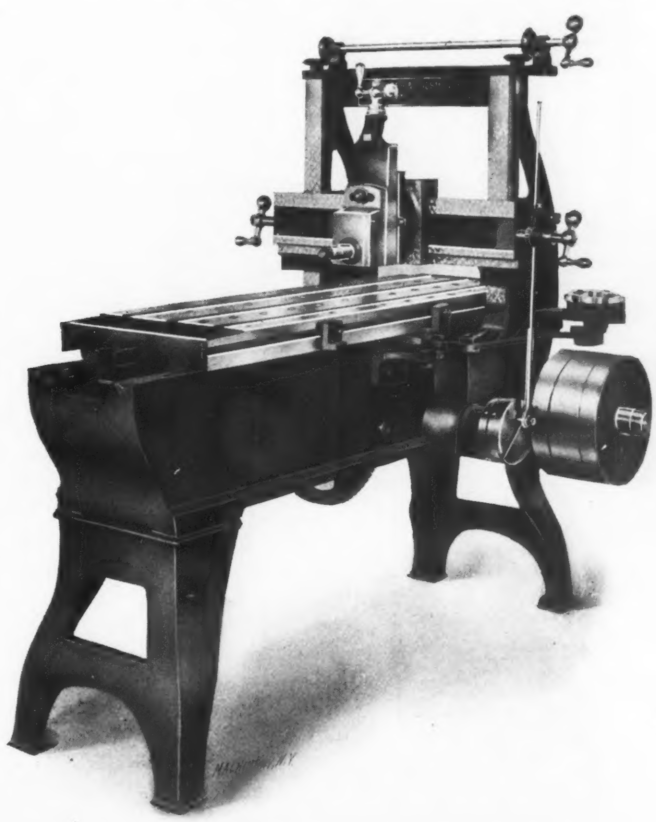
adjusted by a thumb-screw, prevents any lost motion between the sliding head and the rail.

The arbors are inserted in the vertical holes for testing center distances, the gears being placed in the position illustrated. A practical test for noise may be made by placing the arbors in a horizontal position and adjusting the gears to the center distance where they run best. During this test the gears may be driven by a belt.

The equipment furnished with this machine includes two ½-inch arbors, two one-inch arbors, and one 12-inch micrometer checking gage. A shelf, which runs the entire length of the bed, may be used to hold gages, arbors, bushings, etc., when the machine is in use, and the cabinet in the column provides room for storing these parts.

SCHNEIDER & GOOSMANN PLANER

The Schneider & Goosmann Machine Co., 1929 Race St., Cincinnati, O., is now building the design of 16-inch by 16-inch by 3-foot planer shown in the illustration. The various parts of this machine have been carefully proportioned and those which are subject to strain are substantially reinforced. The bed is deep and well-ribbed. The shafts are made of high-grade machinery steel, and all shaft bearings are long. The pulley shaft and also the intermediate shaft run in interchangeable bushings. The table measures three feet inside the scrap pockets, and it has a steel rack four feet long so



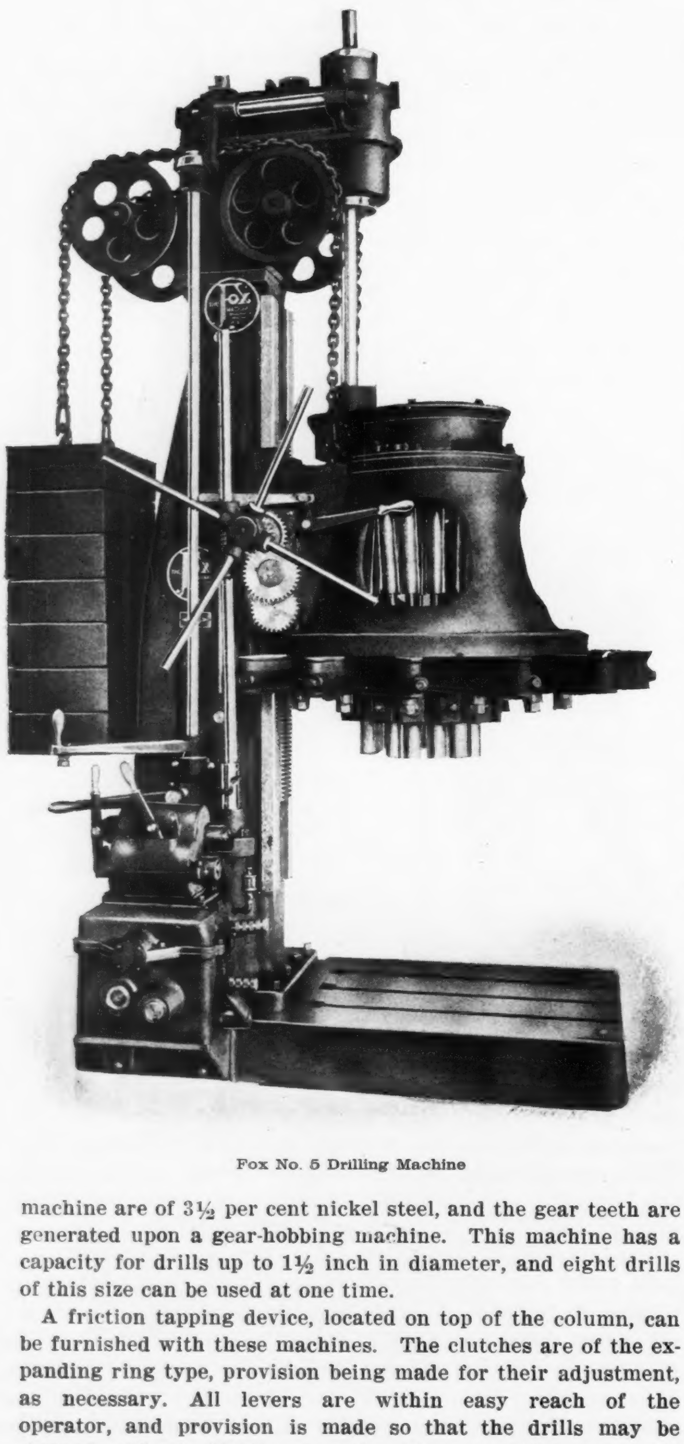
Schneider & Goosmann 16-inch by 16-inch by 3-foot Planer

that work three feet in length may be planed if necessary. A clamping device has been provided to prevent the table from lifting when extreme lengths are being planed. These clamps are located on the inside of the bed at the center and bear upon grooves cut in the table just above the V's.

The belt-shifting mechanism moves one belt entirely off the tight pulley before beginning to move the other on. A safety plunger is provided that prevents the accidental starting of the planer when the driving belts are running on the loose pulleys. The ratio of the belt speed to the cutting speed is 32 to 1, and the width of the belts is 1¼ inch. The head and cross-rail, as well as the housings, are strong and have wide bearing surfaces, which are carefully scraped. The saddle is graduated, and the tool-slide, which has an exceptionally long range, is equipped with a micrometer dial on the feed-screw. The cross-feed is automatic in both directions. The countershaft has tight and loose pulleys 6 inches in diameter by 2 5/8-inch face; the flywheel is 11 inches in diameter and acts as a reversing pulley, and the other pulley is 5 inches in diameter. The net weight of the planer, complete with the countershaft and wrenches, is about 1150 pounds.

FOX MACHINE CO.'S DRILLING MACHINE

The Fox Machine Co., 815-825 N. Front St., Grand Rapids, Mich., has recently placed on the market a new multiple-spindle drilling machine. This machine, which is illustrated herewith, is known as the No. 5 drill, and it is intended for the drilling of gas engine frames, cylinder parts, automobile transmissions, pump flanges and work of a similar character. The machine is designed for either belt or motor drive. When a belt drive is furnished, a single constant-speed pulley is used, which is of large diameter and has a broad face. All changes of speeds and feeds are obtained through gear boxes, and the transmission is of the selective sliding gear type. All driving gears run in oil baths, and all main bearings are self-oiling and are of special bronze metal. The principal gears of the



Fox No. 5 Drilling Machine

machine are of 3½ per cent nickel steel, and the gear teeth are generated upon a gear-hobbing machine. This machine has a capacity for drills up to 1½ inch in diameter, and eight drills of this size can be used at one time.

A friction tapping device, located on top of the column, can be furnished with these machines. The clutches are of the expanding ring type, provision being made for their adjustment, as necessary. All levers are within easy reach of the operator, and provision is made so that the drills may be stopped without shifting the belt. These machines are built to drill to any rectangular lay-out up to 16 by 30 inches or to any circular lay-out up to 24 inches in diameter. The drill spindle bearings and supporting arms are of an improved type upon which patents are pending at this time. The main feature of the drill spindles is the exceptionally strong construction of the spindle bearings and supporting arms, which greatly reduces the drilling strain. Another feature of the spindle construction is that the drills, when set at very close centers, may be raised or lowered, as necessitated by varying lengths of drills.

There are six changes of spindle speeds varying from 200 to 675 revolutions per minute, and 6 changes of head feeds, which vary from 0.787 inch to 6.92 inches feed per minute. A single lever is used for engaging and disengaging the feed mechanism, and there is an adjustable stop for automatically releasing the feed. Special attention has been given to the covering of all gears so as to comply with the requirements of state laws.

This company is using a universal joint of its own design which has all the friction surfaces hardened so as to reduce the wear upon the joint parts. This feature, together with the small number of parts in the joints, gives them an exceptionally long life. The drill illustrated is equipped with a circular head which can be set to drill a lay-out of 24 inches maximum distance between drill centers. The machine weighs 10,000 pounds, and the weight is so distributed that the modern high-speed drills can be driven without straining any part of the machine.

MANVILLE WIRE-FORMING MACHINE

The Manville Bros. Co., 27 Benedict St., Waterbury, Conn., has recently brought out a new design of four-slide wire-forming machine. In the construction of this machine, which is shown herewith, particular attention has been paid to convenience in handling all adjustable parts, the parts having been so arranged that the operator can stand at the front of the machine and reach the clutch lever and the various adjustments for the straightener, feed, cut-off, former, tools and stripper.

The wire straightener on this machine is of the well-known double roll type and it is so placed that the operator can see the wire at all points as it passes between the rolls. The wire feed on the original Manville machine of 1854, was operated from a crank-plate on the end of the side shaft, through rocker-arms and connections to the feed slide. This mechanism has proved so efficient that it has been used in this late model, with such modifications as the present requirements demand.

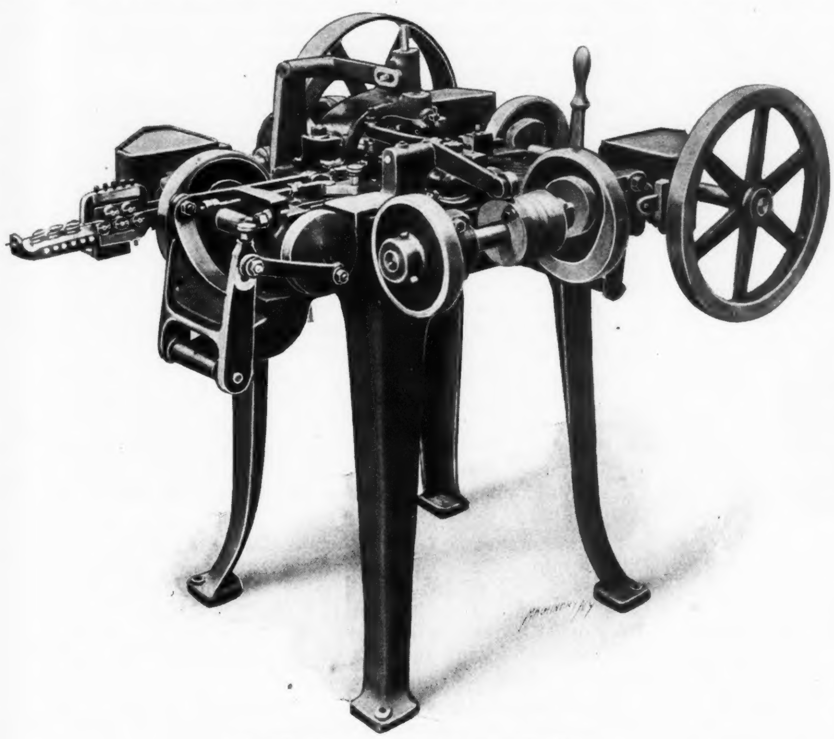
Two adjustments are provided for the feed: A main adjustment at the crank-plate consisting of a binding nut on the crankpin and a knurled adjusting screw for moving the crankpin to and from the center, and an auxiliary adjustment at the top of the rocker-arm (seen to the left) which raises or lowers the end of the main connection. The first is used for rougher adjustments, and the auxiliary for obtaining refinements in the feed not available heretofore. These adjustments in connection with the positive feed stop, eliminate all inaccuracy in feeding and result in perfect work.

The feed grip, which is operated by an independent cam and cross-slide, is so arranged that it will handle either wire or flat band metal. The grip-lever is so pivoted as to make the grip, in a way, self-tightening; that is, the greater the resistance to feeding, the tighter the grip. This grip-lever may be thrown in to or out of action, without stopping the machine, by a knurled handle on top of the lever. The customary slide friction, with its tendency to heat and cut, is not used, thus eliminating a source of much trouble experienced with the old-style feeds. With this feed it is not necessary to adjust the binder cam.

In machines of the older types, it has been customary to loosen two cap-screws, and drive the cut-off bracket to as near the correct position as possible, for the length of wire required. As this method would be out of place when used in combination with the refinements of feed adjustment on this machine, the cut-off bracket is arranged to be adjusted with a screw and miter wheels. With this arrangement, the operator, with one wrench, may loosen the clamp bolt and turn the screw adjustment until the cut-off is in the correct position, giving a degree of accuracy corresponding with that of the feed.

The slides, which are well fitted and scraped to a bearing, are supported by projecting shelves that extend from the edge of the bed, thus supporting them against the downward pressure at the cam rolls.

There has been much objection in older machines to the weak and springy nature of the bracket carrying the former, and, in attempts to overcome this weakness, the bracket has been enlarged until it has cut off the operator's view of the tools and the work. In the later machines built by this company, the bracket is in the form of an arch, and provides such a degree of rigidity that it can be cut away over the tools so as to leave a clear opening for observation of the work. These



Manville Four-slide Wire-forming Machine

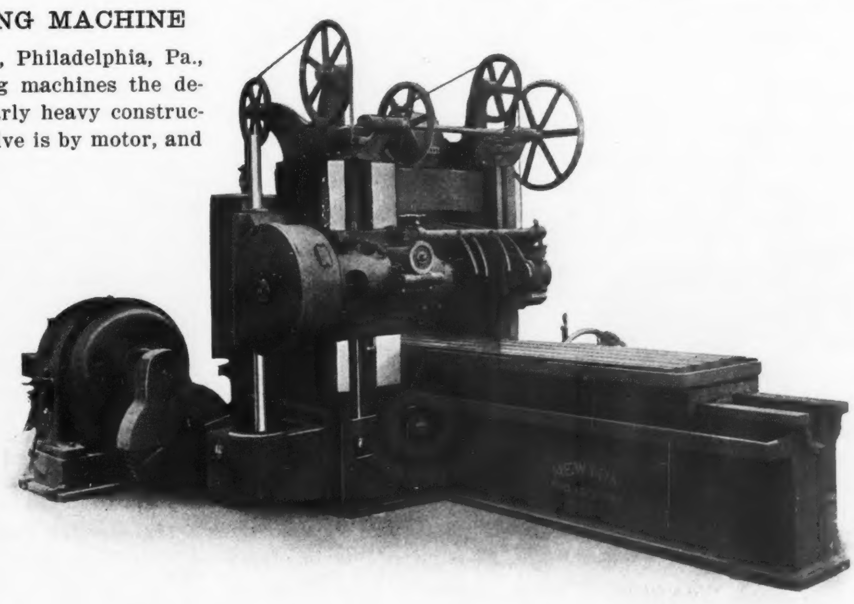
holders are fitted to take either round or rectangular shanks. The stripper lever is carried on an independent bracket bolted to the rear of the bed, and requires no re-adjustment when the form-holder is adjusted.

In place of the old-style tight and loose pulleys, the well-known Johnson clutch has been substituted. The use of a single pulley does away with the necessity for a countershaft, as the machine may be belted direct from the main line.

NEWTON HORIZONTAL MILLING MACHINE

The Newton Machine Tools Works, Inc., Philadelphia, Pa., has added to its line of horizontal milling machines the design shown herewith, which is of particularly heavy construction. As the engraving shows, the main drive is by motor, and there is also a small auxiliary motor for elevating the saddle and outboard bearing. The work-table has a spiral gear and rack drive with a fast reversing traverse and three changes of geared feed.

The spindle is driven by a sleeve worm-wheel (23 9/16 inches in diameter), having a bronze ring with teeth of steep lead. The sleeve of the worm-wheel is 7 inches in diameter, and revolves in a bronze-bushed capped bearing, the main part of which is cast solid with the saddle. The driving worm is of hardened steel and it is fitted with roller thrust bearings, which are encased, thus giving continuous lubrication.



Motor-driven Horizontal Milling Machine built by the Newton Machine Tool Works

The face of the main upright upon which the saddle is mounted is 20 inches wide, and the length of the saddle bearing on the upright is 24 inches. Provision is made for elevating the outer end of the arbor support and the saddle in unison, to maintain alignment. The diameter of the spindle in the driving sleeve is 5 inches and in the main bearing 6 inches. There is a double taper bearing at the nose of the spindle, the large ends of which are 7¾ inches in diameter. The bearings in which the spindle revolves are bronze-bushed. The drive to the cutter arbor is by means of a broad-faced key. The spindle is fitted with a No. 7 Morse taper and it is arranged to hold the cutter arbor in place by means of a through bolt. The spindle sleeve is 9¾ inches in diameter and the bearing is 21¾ inches long. This sleeve has an in-and-out hand adjustment by means of a rack which engages a pinion connecting with the worm-gearing shown. The spindle sleeve is securely held in position by this adjusting mechanism and it is additionally locked by clamping the bearing, which is split.

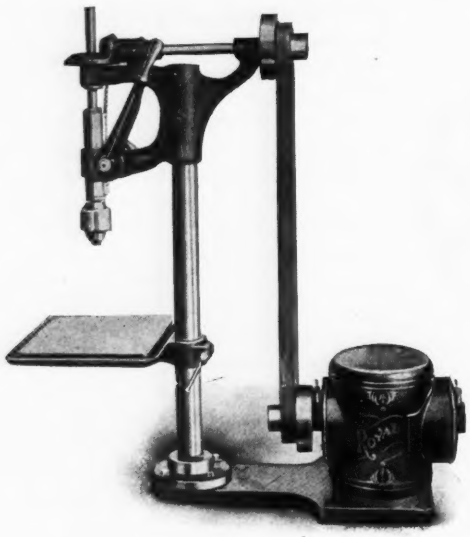
This machine will admit work 30 inches in width between the end of the spindle and the inner side of the outboard bearing, and work 32½ inches high will pass beneath the cross-slide at the top. The distance between the uprights is 34 inches, and the work-table is 27 inches wide by 10 feet 6 inches long over the working surface. This table is of the box-type construction and is entirely surrounded by an oil pan. It has square, lock-gibbed bearings on the bed, and is 6½ inches deep above the shears. The bed is also of the box-type construction and is stiffened by special double ribs.

The outboard bearing has a horizontal adjustment in its support, which is also obtained by means of a rack and pinion movement. The bearing for the cutter-bar is capped and bronze-bushed and is fitted for a 3½-inch arbor. A handwheel is provided for elevating the saddle and outboard bearing, and the table may also be adjusted by a handwheel located on the operating side of the machine. All the operating levers are conveniently located to permit of their control from one position.

ROYAL ELECTRICALLY-DRIVEN SENSITIVE DRILL PRESS

The electrically-driven sensitive drill press shown in the accompanying engraving is made by the A. J. Deer Co., Hornell, N. Y. This machine is designed for automobile factories, garages, general repair shops and, in fact, wherever a light portable tool is needed. The current may be either alternating with a voltage of from 110 to 220, and a frequency of 60 cycles, or direct with from 110 to 220 volts. Three changes of speed may be obtained by means of the three-step driving cones. The spindle of this drill is counterbalanced

and the table has a vertical adjustment and can be swung about the column. The spindle is fitted with a chuck and has a lever feed. The principal dimensions of this drill are as follows: Greatest distance from the chuck to the table, 15½ inches; vertical movement of the spindle, 4 inches; vertical adjustment of the table, 15½ inches; distance from the center of the spindle to the column, 6 inches; size of the table, 10 by



Electrically-driven 12-inch Drill Press

12 inches; drill capacity, 1/2 inch; and net weight, 210 pounds.

The Royal sensitive drills are also made in two other styles, one being a 10-inch machine of the bench type, and the other a 12-inch size similar to the one shown in the illustration but with the addition of a column or pedestal for floor use. The motor for driving the 10-inch drill forms the base, and the drive to the spindle is by a round belt. Five changes of speed are provided on the smaller size and its dimensions are as follows: The greatest distance from the chuck to the table, 8¾ inches; distance from center of spindle to column, 5¼ inches; vertical movement of spindle, 2¼ inches; vertical adjustment of table, 8¾ inches; size of table, 8¼ by 10¼ inches; drill capacity, 1/4 inch; and net weight, 120 pounds.

CLEVELAND ARBOR PRESS

The accompanying engraving illustrates a new and unusually heavy arbor press recently put on the market by The Cleveland Machine Specialty Co., 202 204 St. Clair Ave., N. E., Cleveland, Ohio. The frame is of box construction with a base 5 1/2 inches high and heavily ribbed to the full depth of the frame. The lever is counterweighted as shown, so that when released, it rises to the vertical position, at which point the pawl is automatically raised from the ratchet wheel so that the ram can be quickly adjusted to or from the work by means of the handwheel.

Cleveland Arbor Press

This press will take work up to 20 inches diameter by 15 inches high. It will force a 3-inch arbor into place and is capable of exerting a pressure of six tons. The machine weighs 430 pounds net, and it is designed to withstand the abuse to which these machines are so often subjected.

NEW MACHINERY AND TOOLS NOTES

Cabbaging Machine: Famous Mfg. Co., East Chicago, Ind. Machine for compressing all kinds of scrap metal, worked by hand, producing bales or "cabbages" suitable for re-melting. The machine is intended for the use of brass founders, scrap metal dealers, and manufacturers having much bulky scrap to dispose of.

Motor-driven Polishing and Grinding Stand: Westinghouse Electric & Mfg. Co., Pittsburg, Pa. Portable motor and stand that can be arranged to operate small buffing, polishing and grinding wheels, ventilating blowers, etc. The motor is light and can be easily carried by means of a handle attached to the top of the frame.

Large Shear: Long & Allstatter Co., Hamilton, O. Large shear intended for shearing plates. The heaviest stock that can be cut at one stroke of the slide is 12 feet long and 1 inch thick. The stroke of the shear is 8 inches and the ratio of the gearing is 14 to 1. This machine is entirely self-contained and is equipped with a motor drive.

Wheel-lathe Tool Block: Putnam Machine Co., Fitchburg, Mass. Tool block for driving wheel-lathes, in which the tool is powerfully clamped by a cam-like projection formed on the end of the clamping lever which is raised by a screw that bears on the end of the tool shank, the tool being clamped at the front by the cam and at the rear by the screw.

Change Gear Boxes: New Haven Mfg. Co., New Haven, Conn. Complete quick-change gear-box in which thirty-two gradations of feed for turning or threading may be obtained by the manipulation of two levers. Also change feed box giving three changes which is operated by a single lever. These quick-change boxes are applied to the lathes built by this company.

Tap Wrenches: J. E. Poorman Co., Inc., 1825 Bristol St., Philadelphia, Pa. Tap wrenches furnished in three sizes (Nos. 4, 5 and 6) for taking taps, ranging from 1/16 to 3/16 inch, 1/8 to 1/4 inch, and 3/16 to 7/16 inch, respectively. The shanks have a knurled extension, which is very convenient for backing the tap out at high speed with the thumb and forefinger.

Bench and Toolpost Grinder: New York Electric Tool Co., 136 Liberty St., New York City. Electrically-driven combined bench and toolpost grinder. It can be held in the lathe toolpost for grinding centers, etc., and a rectangular base, which may be readily attached, converts it into a small bench grinder. The weight is 8 pounds and the diameter of the wheel, 3 inches.

Turbine Blower: Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. Two-stage turbine blower which, because of the comparatively low speed required, can be directly driven by motor. Small capacities at high pressures are easily obtained at moderate speeds, for by using two or three stages, the speed can be reduced to that corresponding to one-half or one-third, respectively, of the total pressure.

Combination Rule: E. P. Johnson Rule Mfg. Co., 553 Monroe St., Chicago, Ill. Combination six-inch rule, protractor, tri-square, bevel and caliper. It consists of two parts which are pivoted together to form a protractor, and a sliding piece in one section, which is used as a caliper. The protractor has a vernier reading to one-half degree, and the tool, which is of German silver, is accurately graduated.

Die Casting Machine: Soss Mfg. Co., 435 Atlantic Ave., Brooklyn, New York. Machine for casting parts in metal molds under pressure, using an alloy of low melting temperature and high tensile strength. The metal is melted by gas and a large variety of castings can be made with it, individual molds being required, of course, for each piece. It is claimed that two men can operate it and turn out 4000 pieces per day.

Die Grinder: F. L. Schmidt, 21st St. and 11th Ave., New York City. Die grinder, the spindle of which can be placed either in a horizontal or a vertical position, as required, or at any intermediate position. Wheels are mounted on both ends of the spindle, and the latter may be adjusted while the machine is in motion. The drive is by a quarter-turn belt which connects the countershaft at the rear with the spindle, by passing over idlers at the top of the column.

Transferring Punch: E. C. Bliss Mfg. Co., Providence, R. I. Transferring prick-punch intended particularly for toolmakers' use. It consists of a base-plate and overhanging arm, both of which contain punches in exact alignment. When it is required to transfer a punch mark from one side of a piece to the other, the upper punch is brought down to coincide with one mark, and the second mark is made by pulling down and releasing the lower punch which is actuated by a spring.

Molding Machine: Henry E. Pridmore, Chicago, Ill. Heavy double-shaft stripping plate machines in both round and square types and intended to be operated as roll-overs with the service of a crane and hoist. The operation of making a mold on this machine consists in putting the flask in place, ramming

it up and clamping it to the bottom board of the machine; the entire equipment is then turned over and the pattern drawn from the mold, after which the machine is lifted and returned to the floor for making the next mold.

Four-spindle Indexing Attachment: Garvin Machine Co., Spring and Varick Sts., New York City. Attachment for holding spark plugs while the hexagons are being milled. Four plugs are held at a time and all are indexed simultaneously. The milling operation is performed before the plugs are threaded so that they are held by the smooth ends in double-tapered collets that are tightened by a wrench. When the work is completed, the collets are loosened, and the return of the table operates ejecting levers which force the pieces from the fixture.

Mechanigraph: Topping Bros., 122 Chambers St., New York City. Machine for making opaque drawing paper, on which a drawing has been made in pencil, sufficiently transparent for the production of blueprints. The drawing to be treated is passed between a pair of rolls which carry it through a bath that renders the paper translucent. It is then conveyed along a series of moving tapes to the drying rolls. This machine, with the exception of certain improvements, is similar to the "transparentizer" illustrated and described in the April, 1907, number of MACHINERY.

Tooth-rounding Machine: Schuchardt & Schütte, New York City. Automatic tooth-rounding machine for chamfering teeth of gears used in sliding transmissions, etc. The machine employs a profiling cutter mounted in a spindle, that may be swiveled to angles suitable for any gear tooth. The arbor on which the gears are mounted is indexed by a mechanism that is entirely automatic, thus making the operation continuous. Either a single gear or several may be operated on simultaneously, and the teeth can be rounded on both sides at the same setting. This machine has a capacity for gears up to 12 inches in diameter.

Shear: Cleveland Punch & Shear Works, Cleveland, O. Large shear built for cutting test pieces from plates, I-beams, channels, etc. The main frame is a solid steel casting, which weighs 35,000 pounds. All gears are of steel with machine-cut teeth, and the main driving gear is 7 feet 4 inches in diameter, with a 10-inch face. The flywheel is 6 feet in diameter and weighs 6700 pounds. The shear is provided with a clutch of the 8-jawed type, which is operated by foot-treadle or hand-lever in the usual manner. The drive is by 30 horsepower motor which is connected to the flywheel by a 10-inch belt. The complete machine, exclusive of the motor, weighs 70,000 pounds.

Floating Reamer: Kelly Reamer Co., Cleveland, Ohio. A recent improvement in the Kelly floating reamer, which insures both accuracy and finish without grinding, in cylinders from one inch to twelve inches diameter, and is being used with success for both turret lathe and cylinder work. The improvement consists of an adjustable rigid high-speed boring blade set immediately ahead of the reamer proper, its purpose being to take a final boring cut of about 0.01 inch leaving but 0.003 inch for the reamer to remove, and thus reducing the work done by the reamer blades. Reamers of this type have in the automatic machines at the plant of Timken Roller Bearing Co., Canton, Ohio.

Upright Drill: Mechanics Machine Co., Rockford, Ill. This machine is a recent addition to the line of upright drills manufactured by this company. The size is 28 inches, and the design is similar to the No. 32 machine illustrated in the April number of MACHINERY. There are eight changes of feed available, ranging from 0.004 to 0.051 inch per revolution of the spindle. All feed gears are milled from solid stock, and the drill is equipped with a geared tapping attachment if required. The head is adjustable on the column, and the maximum distance from the spindle to the base is 56 inches. The vertical feed is 13 inches, and the distance from the column to the center of the table is 14½ inches. The diameter of the column is 8 inches, while the spindle diameter in the sleeve is 1 15/16 inch.

Single-stroke Open-die Header: E. J. Manville Machine Co., Waterbury, Conn. Improved type single-stroke open-die header intended for heading long rivets, wood-screw blanks, bolts, etc., which are subsequently shaved to remove surplus stock and the fin under the head caused by the joint in the gripping and heading dies. This machine can also be employed for cutting and heading wire, where the fin marks are not objectionable. It is built in six sizes; the smallest size has a capacity for diameters up to 1/8 and a length of 1½ inch, and the largest, for diameters of ⅝ inch and lengths of 7 inches. This type lends itself to greater speed than a solid die, as the feeding of the stock ejects the finished piece without loss of time, and also because the blank is brought quickly in line with the heading punch.

Micrometer Caliper: Gilbert, Harris & Co., Chicago, Ill. Universal micrometer caliper which may be used for inside or outside measurements within its range. It has a range of 4 inches inside the frame, and the adjustments may be locked when set. The frame is drop forged and contains a sliding rod in one end for quick adjustment and a micrometer screw in the other for fine measurements and adjustment. This caliper can also be used for taking inside measurements, the sliding rod on one end and the micrometer head on the other being pointed for this purpose. There is also provided an attachment in the shape of two drop-forged arms which fit the sliding rod, so that the caliper may be set to two measurements at one time. These arms may also be used independently for a variety of purposes.

Piston Ring Grinder: Bay State Grinder Co., Worcester, Mass. Improved design of piston ring and surface grinder, having ample weight and stiffness to meet the requirements of any work within its capacity. The machine has a Walker magnetic chuck that is attached to a vertical spindle, which, in turn, is driven by spiral gears from the cone shaft, the gears running in an oil bath. This chuck is elevated by a graduated handwheel. The head on which the emery wheel is mounted is adjustable so that saws, cutters, etc., may be ground convex or concave if desired. This head is provided with three feeds. The spindles and shafts are ground, and have adjustable bushings that are thoroughly protected from dust. The pedal clutch-operating device is a noteworthy feature, as it enables the operator to start and stop the rotation of the chuck with his foot, so that the hands are left free. This same pedal also connects and disconnects the circuit which supplies the current for the chuck, though this can be operated by hand. The machine can be equipped with a vertical spindle and cup-wheel, if desired, and it can be arranged for either wet or dry grinding. A valve face grinding attachment for grinding single cams can also be supplied. A countershaft is not necessary as the drive is direct from the main shaft.

* * *

CORRECTION TO CARTER & HAKES BENCH MILLING MACHINE DESCRIPTION

In the article descriptive of the bench milling machine manufactured by the Carter & Hakes Machine Co., of Winsted, Conn., which appeared in the September number, the statement was made that the machine is built in two styles, one being a hand milling machine, with or without a vertical attachment, and the other a machine with both hand and power feeds for the table. This is erroneous, as the bench machine is not made with power feed or with a vertical attachment. The No. 3 hand milling machine built by the company can, however, be furnished with or without a vertical attachment, and also with both hand and power feeds for the table.

* * *

FLUX FOR BRASS FOUNDRY WASHINGS

In the melting of washings from brass foundry ashes, a flux must be used unless they are washed very clean. Even with clean washings a flux is advisable. The same applies to grindings, skimmings and similar waste materials. Unless a flux is used when they are melted, a union of the particles of metals is prevented by the presence of so much foreign matter, and instead of the full amount of fluid metal there is usually obtained a small quantity in the bottom of the crucible and a large mass of pasty material fritted together. When a flux is used the foreign matter is dissolved and clean metal is left. For a flux in melting brass, bronze or composition washings, grindings, skimmings and other material, I have found nothing better than plaster-of-paris. It is cheap and excellent for this purpose. It possesses the property of dissolving what foreign matter may be present in the shape of sand, slag or oxide, and it has practically no action on the crucible; any desired quantity can be used. It melts readily and forms a thin slag. To melt washings or grindings with plaster-of-paris, mix about 5 pounds of it with the washings when they are placed in the crucible. Then melt in the usual manner. If the slag at the conclusion of the melt is not sufficiently fluid, more should be added. When the metal is completely melted pour the entire contents of the crucible into ingot molds. Do not attempt to skim it. The slag will run into the molds with the metal and rise to the top. Allow the mass to cool and then dump the ingot molds. The slag of plaster-of-paris can be readily detached by a blow from a hammer, or it usually will fall off.—*Edwin S. Sperry in paper read before American Brass Founders' Association convention.*

ADDITION TO THE RYERSON PLANT

Joseph T. Ryerson & Son of Chicago have in course of erection additions to their already large plant, which will give them an increase of floor space, of approximately 85,000 square feet, making a total building floor area of over 800,000 square feet.

The new buildings are two in number—one is to be devoted to machinery warehousing and display and demonstration rooms, and the other to the storage of structural shapes and specialties. Both new buildings follow out the same general engineering and architectural design adopted throughout the plant. The addition to the machinery demonstration and display rooms is located north of the present machinery warehouse on Rockwell St., extending north to 14th St. This building is 350 feet long and 75 feet wide, of steel and brick construction with tile and glass roof. The floor is 3-inch planking crossed with matched hard maple over concrete. This building will be served by a 15-ton crane, spanning the full width of the building, the runways of which will extend over double switch tracks and a wagon runway at the south end of the building.

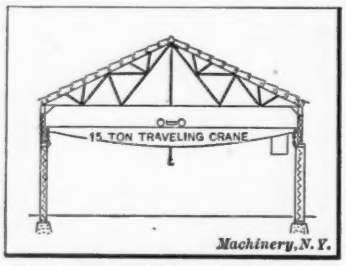


Fig. 1. End Elevation, Machinery Demonstrating Building, Joseph T. Ryerson & Son, Chicago

The building will be piped for compressed air, steam, gas and water, and both alternating and direct electric current will be available in all parts, which with lineshafting and belting will enable the company to test or practically operate any kind of machine. The building is of fireproof construction throughout, and when completed will be the largest machinery display and demonstration room devoted to an individual concern.

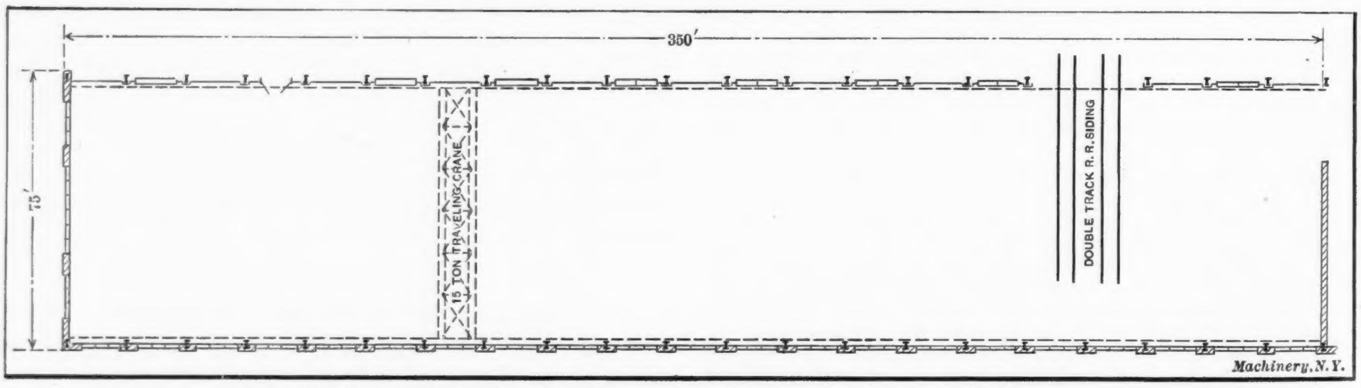


Fig. 2. Plan of Machinery Demonstrating and Display Building, Joseph T. Ryerson & Son, Chicago

The structural specialty building is immediately south and adjacent to the present structural warehouse and extends 500 feet from Rockwell St., east to the Pennsylvania tracks. The building is 100 feet wide and of steel construction throughout. This building will be served by two cranes, each of 5 tons capacity and with 100 foot span. Double switch tracks extend across the east end, while in the west end there is a wagon runway.

These extensive additions to the Ryerson plant, coming at this period of general dullness and unsettled business conditions, are significant as representing the progress which that company has made in the "steel department store" idea and as further exemplifying the success which has attended such concerns as are in position to cater to the entire wants of the steel users.

* * *

At a recent meeting of the National Association of Cotton Manufacturers, Mr. Jos. Hope, of Rouen, France, exhibited a sample of a substitute of cotton made from spruce wood pulp. Cloth woven from the fiber is said to stand bleaching, dyeing and finishing as well as cotton, and to have a more brilliant luster. It is stated that it can be produced at a smaller cost than the market price of cotton, and that arrangements are made abroad for its manufacture on a large scale.

DON'TS FOR ELECTRICIANS*

By H. E. WOOD†

Don't run wires crooked.
Don't use unenclosed fuses.
Don't put in wiring loosely.
Don't put up cleats with nails.
Don't use acid in soldering joints.
Don't nick a wire when skinning it.
Don't allow contacts to become dirty.
Don't read a meter from left to right.
Don't leave bad joints in the molding.
Don't put up any circuit without a fuse.
Don't let a switchboard get out of repair.
Don't leave any conduit pipe ungrounded.
Don't forget that mica is a good insulator.
Don't use the edge of a knife to clean wire.
Don't put too much tension on a drop light.
Don't work on inside wiring, with current on.
Don't leave conduit pipe improperly supported.
Don't leave a piece of work without testing it.
Don't forget that all joints should be soldered.
Don't throw a switch lever in or out too slowly.
Don't leave any binding bolts or contacts loose.
Don't put up rosettes without their proper fuse.
Don't leave litter or rubbish around a generator.
Don't use emery cloth or paper on a commutator.
Don't put fuse plugs where water can get at them.
Don't use pliers unless the handles are insulated.
Don't put in iron bolts where brass ones should go.
Don't be wasteful of wire or tape; they cost money.
Don't let the commutator get dirty or gummed up.
Don't let wires sag; they present a bad appearance.
Don't put any pulling strain on a portable lamp cord.
Don't make a splice without having the wires clean.
Don't try to replace fuses without pulling the switch.
Don't let a switch blade arc when throwing it in or out.
Don't put a motor or generator on a shaky foundation.
Don't overload a motor or generator for too long a time.
Don't believe that a wire is "dead" because others say so.
Don't slant holes downward where wires enter a building.
Don't leave loose bolts or nuts near a motor or generator.
Don't install a motor or generator in a damp or wet place.
Don't throw a switch before you know how it is connected.
Don't burn the insulation on wires while soldering a splice.
Don't splice a small wire and a large one together in a line.
Don't put in a lighting circuit without having it well fused.
Don't enclose a motor or generator so that it cannot get air.
Don't forget the lugs on switches for wire larger than No. 8.
Don't use dry batteries where a constant current is desired.
Don't leave dirty waste lying on a switchboard or rheostat.
Don't attempt to trim an arc light with "juice" on the wires.
Don't leave an open keg of nails near a generator or motor.
Don't leave the end of a conduit pipe without a bushing on it.
Don't put your hands on a generator when it is not necessary.
Don't shift the brushes when a motor is running at full speed.

* For "Don'ts" previously published in MACHINERY, see "Don'ts for Draftsmen" and "Don'ts for the Prevention of Accidents in the Machine Shop," July, 1910; "Don'ts for Planer Men," June, 1910; and "Don'ts for Machinists," March, 1910, with accompanying references.
† Address: 182 N. 4th St., Newark, N. J.

Don't forget that electricity is like the wind; it can't be seen.

Don't use a screwdriver unless the handle is properly insulated.

Don't put in a new brush without fitting it to the commutator.

Don't forget that rosin makes a good flux for soldering splices.

Don't think that all adults can stand the same amount of current.

Don't depend upon your head entirely to remember a wiring diagram.

Don't let a motor or generator run when it is sparking excessively.

Don't work on a running generator or motor with steel or iron tools.

Don't disconnect wires without tagging them, if they are to go back.

Don't fail to place switches where they will be handy in case of fire.

Don't carry steel tools in your pocket when working around a generator.

Don't get into the habit of twisting wires both ways in making splices.

Don't forget that platinum makes the most satisfactory sparking points.

Don't overload a circuit beyond the carrying capacity of the conductors.

Don't put your fingers on a commutator, as the oily effect is bad for it.

Don't splice an insulated wire and leave it without winding it with tape.

Don't put wires in dangerous places without protecting them thoroughly.

Don't throw the rheostat lever up too quickly, but give it the proper time.

Don't sweep the floor or raise dust near a generator when it is running.

Don't forget that pure coin silver makes a very satisfactory contact point.

Don't start up a new motor or generator without a thorough examination.

Don't use anything but authorized fuse in places where fuse wire is to go.

Don't put two solid carbons, or two cored carbons in an alternating current arc lamp.

Don't put wires near together crosswise, without bushings or circular loom work between.

Don't leave a key in a socket switch unless you are willing to have it tampered with in your absence.

Don't solder a joint up close to a wall or woodwork without asbestos protection between it and the wires.

Don't forget that dental cement will fill the crevices where mica is broken out of a commutator, and that it is a very efficient insulator.

Don't wind a large wad of tape over a splice, as it is sufficient to have the wire covered; the splice need not be much larger than the wire in other places.

Don't forget that both a generator and a motor should have a good blowout with a strong blast of air occasionally, to get rid of all the dust which accumulates there.

* * *

The exhibit of the commissary department of the United States Navy at the Domestic Science and Pure Food Exposition, Madison Square Garden, New York, September 17-24, gave visitors some idea of the extent to which machinery and apparatus is used on United States naval vessels for the preparation of food. The exhibit was of interest from an engineering standpoint, showing, as it did, advanced types of machinery for bread mixing, potato peeling, etc., and electrical apparatus for roasting, broiling and general cooking. Electrical ranges have the advantage of requiring only about three-fourths the space of coal ranges of equal capacity—a very important consideration in the equipment of a battleship, on account of the limitations of space.

INSPECTION OF YALE & TOWNE MANUFACTURING METHODS

The hoist sales department of the Yale & Towne Mfg. Co., New York, represented by Messrs. R. T. Hodgkins, manager of the hoist department, and H. C. Spaulding, New York district manager, entertained about thirty salesmen of the leading concerns selling Yale & Towne hoists, and others, on the afternoon and evening of September 16. The party inspected the factory at Stamford, Conn., and were then given a shore dinner at the Stamford Yacht Club House on Shippan Point. The object of the "get-together" was to impress on the salesmen the high quality of Yale & Towne products by showing them the processes of manufacture and methods of inspection, and to give them a forecast of the company's selling policy. The party evinced great interest in the manufacturing practice followed in making locks, builders' hardware, hoist chain, hoists, etc. The event is one that will be long remembered with pleasure by those whose good fortune it was to participate.

* * *

A brilliant example of the remarkable progress of aviation in 1910 is the achievement of George Chavez, a Peruvian, who flew over the Alps from Brigue, Switzerland, to Domodossola, Italy, September 23. Chavez made the flight in an attempt to win the prize of $20,000 offered by the Italian Aviation Society for a flight from Brigue to Milan, Italy, a distance of seventy-five miles. He followed the general route of Napoleon's famous road over the Alps through the Simplon Pass, and rose to a height of between 8000 and 9000 feet, thus probably breaking his own altitude record of 8271 feet, made September 3. Unfortunately Chavez lost control of his monoplane at that great height through the benumbing effect of cold and practically fell with the machine thousands of feet until near the ground where he recovered partial control and the fall was broken, but the daring aviator was so badly hurt that he died four days after.

* * *

A government report from Washington indicates that bicycling as a pastime is rapidly decreasing in popularity both abroad as well as in America. Statistics show a great falling off in exports of bicycles from the United States. In 1897, when bicycling was at the zenith of its popularity, $7,005,323 worth were exported; in 1900, the exports amounted to $3,553,149; and during the last fiscal year the exports totalled only $620,760.

* * *

PERSONALS

Clifford Talbot, formerly with James Cunningham, Son & Co., Rochester, N. Y., has been made superintendent of the Selden Motor Vehicle Co. of Rochester.

Chester B. Hosford, for many years superintendent of the Haydenville Co., Haydenville, Mass., has taken the position of superintendent of the Bay State Brass Co., of Haydenville.

J. B. Canfield, master mechanic for the Boston & Albany R. R. at the Allston, Mass., shops, has been promoted to division master mechanic at the West Springfield, Mass., shops.

John B. Milliken has resigned the position of comptroller of the Crocker-Wheeler Co., Ampere, N. J., and taken the position of treasurer of the Yale & Towne Mfg. Co., Stamford, Conn. Mr. Milliken's headquarters will be in New York.

A. J. Fries, division master mechanic of the Boston & Albany R. R. at the West Springfield, Mass., shops, has been promoted to the position of division superintendent of motive power for the New York Central & Hudson River R. R., Buffalo, N. Y.

William H. Amidon, of Millers Falls, Mass., the only survivor of the original fifty workmen who started with the Millers Falls Co. forty-one years ago, was recently given a surprise party on his seventy-sixth birthday by over one hundred of his fellow workmen.

William M. Chamberlin, formerly secretary and treasurer of the Adcraft Club, Detroit, Mich., and general promotion manager of the Detroit Lubricator Co., Wright Mfg. Co., and the Austin Separator Co., has been appointed manager of the bureau of general promotion of the American Supply & Machinery Dealers Association, of Detroit.

Critchley Parker, publisher of the *Australian Mining Standard*, Melbourne, Australia, made a brief visit to the United States in September in the interests of the Australian com-

monwealth, his mission being to awaken in American manufacturers and business men an appreciation of the great opportunities for the development of industrial enterprises in Australia and its large potential market for machine tools, machinery of all kinds, etc.

Charles F. Kenworthy, a furnace engineer until recently with the engineering department of the American Brass Co., and formerly of the Kenworthy Engineering Co., has been engaged by the Rockwell Furnace Co., 26 Cortlandt St., New York, to represent it in the New England states and Canada. Mr. Kenworthy has devoted his entire time for the past eighteen years to the design and construction of furnaces and fuel apparatus and brings with him a large acquaintance among the builders and users of this line.

James Sherwood, a well-known steel salesman, has been appointed Canadian agent for Thomas Firth & Sons, Ltd., Sheffield, England. Mr. Sherwood took full charge of the Canadian trade October 1, with headquarters in Montreal. For five years past Mr. Sherwood has filled a responsible position in the sales organization of E. S. Jackman & Co., Chicago, Ill., agents for the Firth-Sterling Steel Co. Prior to that engagement he was the railroad representative in Canada of the Ewald Iron Co. He was closely associated in the development of the Firth-Sterling business in Chicago, and, also having had valuable experience as assistant manager and salesman in the old Chicago staff of Howe-Brown & Co., and Park Bros. & Co., is well qualified for his present position.

* * *

OBITUARIES

George M. Gerry, for over fifty years a manufacturing machinist at Athol, Mass., died August 31, aged seventy-three years.

Aaron W. C. Williams, treasurer and manager, and one of the founders of the Capewell Horse Nail Co., Hartford, Conn., died August 4.

M. M. Joslyn, of Springfield, Mass., died recently in Yokohama, Japan, aged thirty-nine years. Mr. Joslyn was a skilled draftsman and toolmaker, and had held several important positions. He went to Japan about a year ago as manager of the American Graphophone Record Co. of New York. He formerly was superintendent of the American Record Co. which was absorbed by the trust three or four years ago.

John W. Russell, president of the John W. Russell & Sons Co., Springfield, Mass., died at his home August 31, aged eighty-seven years. Mr. Russell began his apprenticeship to the machinist trade seventy-two years ago with Zelotus Lombard, and with the exception of a short run of "California gold fever" in '49 and '50, had been continually in the machinists' trade and manufacturing. Mr. Russell established the business, now conducted by his sons and which has been a continuous and successful enterprise, in 1865.

George Henry Baush died at Northfield, Mass., September 12 with an abscess on the lungs, aged forty years. Mr. Baush, born in Holyoke, Mass., was the son of C. H. Baush, the founder of the present Baush Machine Tool Co., of Springfield, Mass. He and his brothers formed a partnership with their father under the firm name of C. H. Baush & Sons, and moved to Springfield where the business is now located. Later the firm name was changed to Baush & Harris Machine Tool Co., and still later to the present name. Mr. Baush was superintendent of the concern for several years, leaving it a few years ago and taking up the selling of machinery. He gave up the position of sales manager of the Fay Machine Tool Co., Philadelphia, Pa., last spring on account of ill health.

CHARLES T. PORTER

Charles T. Porter

Charles T. Porter, the famous engineer, inventor, author, "father of the high-speed steam engine," and promoter of many improvements in steam engineering practice and design, died at the home of his son, Mr. L. M. Porter, New York, August 29, in his eighty-fifth year. Mr. Porter was educated to be a lawyer, and practiced law with indifferent success for a few years. Then, becoming interested in the invention of a stone-dressing machine made by one of his clients, he abandoned law to promote it and thus became interested in engineering. The original invention was worthless and considerable money was sunk by Mr. Porter and his friends in its development. In the struggle to make the machine work he conceived an improved machine which was built and worked successfully. The operation of this machine required much power, and great trouble was met with in regulating the engine, which was of the old-style, long-stroke, fly-ball governor type. This trouble led to the invention of the Porter governor in 1858, and made him acquainted with the general defects of the common type of slow-operating steam engines then in use. The Porter-Allen steam engine, in which the governing function was effected through controlling the action of the slide valve instead of throttling the steam pipe, was the work of Mr. Porter and James F. Allen with whom he became acquainted in 1860-61. The two were closely associated for ten years. The development of the Porter-Allen high-speed engines, which ran with such steadiness under extreme fluctuations of load as to make electric lighting practicable, and made direct-connected engines and dynamos possible in 1880, was, it might be said, the direct result of Mr. Porter's experience with the stone-dressing machine. The development of the high-speed steam engine led to many improvements in machine design and manufacturing practice, and it would be difficult to estimate the great influence of his work on engineering practice in general. Mr. Porter's conception of a high-speed engine of much greater power for a given unit of weight than the slow-speed engine has had a profound effect on prime mover design. The multiple-cylinder high-power gas engine weighing, say ten pounds or less per horsepower in the case of the automobile and three pounds or less for the aeroplane, is the logical result of his pioneer work. The story of his life fills a large volume entitled "Engineering Reminiscences," published in 1908, and is a remarkable record of engineering progress made in the fulfilment of an idea. Mr. Porter's work in England and America brought him into contact with most of the leading engineers of the age, and the book is replete with incidents that occurred in his intercourse with them. He was a remarkable mechanical genius, but unfortunate in many of his business affiliations and his life was somewhat embittered by the dishonesty and treachery of trusted associates. On the other hand, the hearty recognition accorded him by the engineering world was most gratifying. He was an honorary member of the American Society of Mechanical Engineers, and in 1909 was presented with the John Fritz medal which is conferred by the four national engineering societies, *viz.*, American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, and American Institute of Electrical Engineers, for notable industrial or scientific achievement. Mr. Porter was the fifth to receive the medal, the others being Lord Kelvin, Alexander Graham Bell, George Westinghouse, and Thomas A. Edison. Mr. Porter's home was in Montclair, N. J., where he had lived for several years. Following the death of his wife in July, he removed to New York to the home of his son.

* * *

COMING EVENTS

October 9-12.—Second International Congress of Refrigeration, Vienna, Austria. For further information address Mr. F. W. Pilsbury, 1660 Monadnock Building, Chicago, Ill.

October 10-14.—Annual convention of the American Street and Interurban Railway Association, Atlantic City, N. J. H. C. Donecker, secretary and treasurer, 29 West 39th St., New York.

October 25-6.—Annual convention of the National Machine Tool Builders' Association, New York. Hotel Astor headquarters. Charles E. Hildreth, secretary, Worcester, Mass.

October 27.—MACHINERY'S eighth annual outing.

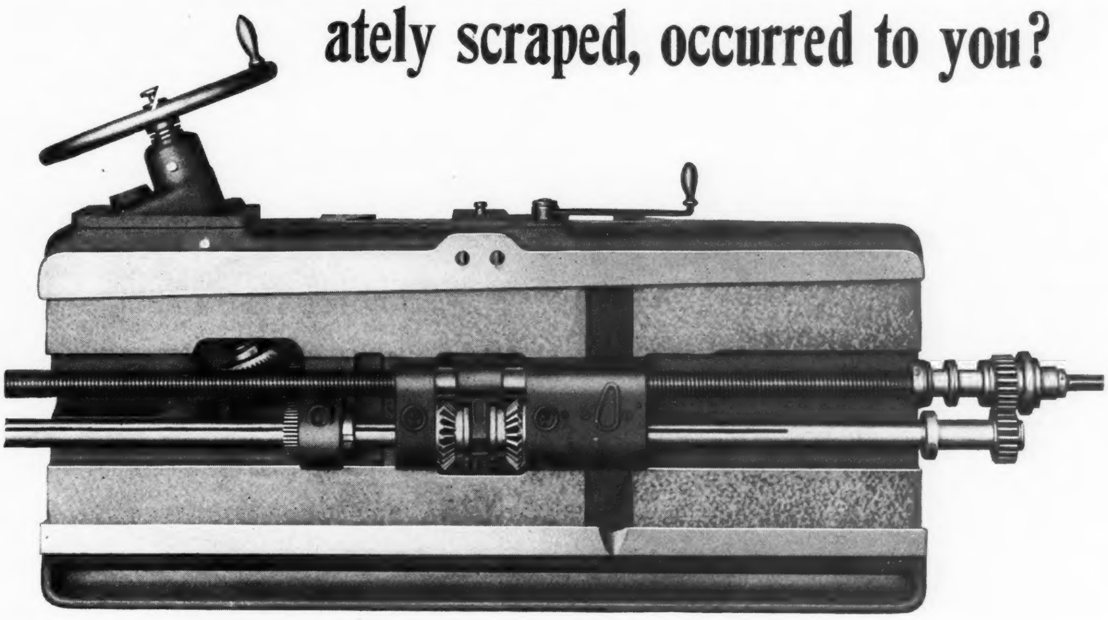
November 17-19.—Fourth annual convention of the National Society for the Promotion of Industrial Education, Boston, Mass. A feature of this convention will be a lecture on "Continuation Schools," by Dr. George Kerschensteiner, superintendent of schools, Munich, Germany. James B. Monaghan, secretary, 20 West 44th St., New York.

December 12-15.—Convention of the National Gas and Gasoline Engine Trades Association, Racine, Wis. Albert Stritmatter, secretary, Cincinnati, Ohio.

SOCIETIES AND COLLEGES

BULLETIN OF THE ARMOUR INSTITUTE OF TECHNOLOGY. General information number containing catalogue of courses for the present school year. Frederick U. Smith, comptroller and secretary, Chicago, Ill.

Has the importance of ample bearing surfaces, accurately scraped, occurred to you?



In the construction of **B. & S. Milling Machines** great emphasis is placed upon this one feature, in that long and wide flat bearings and liberal cylindrical bearings, scraped carefully to surface plates and standards, are the most important factors in producing and maintaining alignments and accuracy.

Note how the back of the knee extends above the top, a feature which prevents sagging of the knee when carrying a heavy load. Also note the wide bearings for the saddle, eliminating any bending strains under heavy cuts. Then study the length of the table bearings on the saddle which permits cuts to be taken easily and accurately to the full length of the table. Such features as these are the ones that should be borne in mind when purchasing a Milling Machine. Cylindrical bearings, although not illustrated here, receive the same attention as the flat.

Our General Catalogue shows a full line of Milling Machines.

Brown & Sharpe Mfg. Company

Providence, R. I., U. S. A.

TRAVELING ENGINEERS ASSOCIATION. Committee reports and subjects for discussion, 18th Annual Meeting, Niagara Falls, Canada, August 16-19. W. O. Thompson, secretary, N. Y. C. Car Shops, East Buffalo, N. Y.

NATIONAL ASSOCIATION FOR THE PROMOTION OF INDUSTRIAL EDUCATION. The Factory School of Rochester, by George M. Forbes. The National Importance of Education, by Dr. R. Rhees. Arthur L. Williston, secretary-treasurer, Pratt Institute, Brooklyn, New York.

NEW BOOKS AND PAMPHLETS

VIBRATIONS OF SYSTEMS HAVING ONE DEGREE OF FREEDOM. By B. Hopkinson. 54 pages, 5½ x 8½ inches. Published in the United States by G. P. Putnam Sons, New York. Price 75 cents.

MODEL BALLOONS AND FLYING MACHINES. By J. H. Alexander. 127 pages, 5 x 7 inches, 45 illustrations, 5 inserted plates. Published by Norman W. Henley & Son, 132 Nassau St., New York, and Crosby Lockwood & Son, London. Price $1.50.

The success of the aeroplane has tremendously stimulated popular interest in balloons, dirigibles, and heavier-than-air flying machines of all kinds. It was the aim of the author to give the reader a history of the art up to date, and an idea of its present state as far as possible. It describes early balloon flights, the spherical balloon, the parachute, the dirigible balloon, fire balloons, how to inflate a model balloon with gas, a model airship, fundamental principles of flight, gliders, aeroplanes, Maxim's flying machine, biplane and monoplane flying machines, Farman, Voisin, Wright, Bleriot, and other biplanes. The concluding chapter gives a glossary of terms used in describing flying machines with suitable sketches to illustrate.

POWER GAS AND GAS PRODUCERS. By J. C. Miller. 184 pages, 5 x 8 inches. 18 illustrations. Published by Popular Mechanics Co., Chicago, Ill. Price $1.

It is freely predicted that the gas engine and gas producer will eventually replace steam engines and steam boilers for power purposes, especially in the larger plants. It is scarcely twenty years since gas producers were first introduced and in that short time the development of the gas producer plant has been most remarkable. This work treats of producer gas and its chemistry, heat values of various gases, gas producer fuels, types of gas producers, including Siemens, Wiley, Smith, Taylor, Loomis, Pettibone, and Morgan. Chapter VII is on gas producer operation. The efficiency of a producer plant is compared with that of a steam plant, and some causes of producer troubles are touched on. The concluding chapter is on gas producer installation, the erection of the plant, preliminary testing, water seals, gas holders, rules of the International Board of Fire Underwriters, etc.

CHEMISTS' POCKET MANUAL. By Richard K. Meade. 443 pages, 4 x 6¼ inches. Published by the Chemical Publishing Co., Easton, Pa. Price $3.

This work is a practical hand-book containing tables, formulas, calculations, information, physical and analytical methods for the use of chemists, chemical engineers, assayers, metallurgists, manufacturers, and students. It has been the author's aim to present in as condensed form as possible such information as would seem to be of service to those interested. The work is one that can be highly commended. It is concise, compact and contains a large fund of valuable information, the contents being substantially as follows: metric and United States weights and measures, metric tables, mensuration, international atomic weights, stoichiometry, graphic methods of saving calculation, conversion tables, specific gravities of solids and liquids, weight and volume of substances, standard tables of the specific gravity of sulphuric acid, nitric acid, hydrochloric acid and ammonia, Lunge's and other tables of specific gravity of acids and alkalies, physical properties of gases, hygrometers, solubility, boiling point and melting point, standardizing weights, calibration of chemical glassware, temperature, heat, combustion, radiation, steam, electricity, mechanics, mineralogy, geology, volumetric solutions, standardized volumetric solutions, reagents used in quantitative and qualitative gas analysis, test papers, assaying, analysis of iron ores, analysis of coal, analysis of blast furnace slags, analysis of soap, etc.

HIGH-SPEED STEEL. By O. M. Becker. 360 pages, 6 x 9 inches. 273 illustrations. Published by McGraw-Hill Book Co., New York. Price $4.

This work, is, we believe, the first comprehensive treatise on high-speed steel, its development, treatment and use, notwithstanding the fact that high-speed steel was first brought to the attention of the engineering world by Messrs. Taylor and White more than a decade ago. Space will permit us to give only a running review of the contents of this interesting and valuable book. It begins with a historical account of ancient steels and takes up the development of steels of the high-speed variety. Section II treats of the making of steel and tools, forging, hardening, tempering, annealing, grinding, etc. Section III is devoted to the use of high-speed steel tools treating of the range of usefulness and maximum effect, speeds, feeds, and related matters. Considerable space is given to the researches of Mr. Taylor, which were recorded in his paper "On the Art of Cutting Metals" presented before the American Society of Mechanical Engineers, December, 1906. In fact a considerable part of the work has been published elsewhere in the proceedings of engineering societies and the technical journals to which the author has contributed for several years. He has skillfully compiled these related articles and written new matter, thus producing a comprehensive treatise on the art of high-speed steel tool making and use that should be highly appreciated by works managers, superintendents, foremen and others concerned with obtaining the highest efficiency of metal-working tools.

CATALOGUES AND CIRCULARS

GENERAL ELECTRIC CO., Schenectady, New York. Bulletin No. 4754 on mill type motors.

NEWALL ENGINEERING CO., Walthamstow, London, E. Catalogue of gages, micrometers and measuring machines.

INGERSOLL-RAND CO., 11 Broadway, New York. Form 4102 illustrating Sergeant rock drills, and component parts.

SPRAGUE ELECTRIC CO., 527-531 West 34th St., New York. Bulletin No. 235 on motor-driven disk and propeller fans.

KOLESCH & CO., 138 Fulton St., New York. Circular of Richter drawing instruments. Copies will be sent to any address on request.

OSWEGO MACHINE WORKS, Oswego, New York. Illustrated catalogue of cutting machines for cutting paper, books, boxes, board, cloth, tinfoil, leather, etc.

GOLDSCHMIDT THERMIT CO., 90 West St., New York. Circular illustrating butt welded pipe joints for ammonia, steam, hydraulic, and compressed air plant installations.

SIMPLEX MFG. CO., 90 West St., New York. Circular of Simplex combination bench file and metal back-saw, and price list of parallel files and hack-saws used therewith.

G. R. LANG CO., Meadville, Pa. Leaflet illustrating manufacturing tool-holders suitable for vertical boring mills, and a new design of tool-holder for lathe and shaper work.

NATIONAL BRAKE & ELECTRIC CO., Milwaukee, Wis. Catalogue No. 391, illustrating and describing various types of National air compressors of self-contained and motor-driven types.

GOLDEN-ANDERSON VALVE SPECIALTY CO., Fulton Building, Pittsburg, Pa. Circular of Golden-Anderson automatic cushion, non-return and triple action valves for steam and water service.

ROWBOTTOM MACHINE CO., Waterville, Conn. Circular of the Rowbottom 18-inch double end ball bearing disk grinder which was illustrated and described in the September number of MACHINERY.

LIVERIGHT BROS., Philadelphia, Pa. Leaflet illustrating "Gold Medal" electric files, which represent a general departure in spacing, angle of pitch and teeth, resulting in rapid cutting and true, smooth surfaces.

GRANT & WOOD MFG. CO., Detroit, Mich. Circular and price list of steel balls made by the company. The G. & W. balls are furnished in special steel, chrome steel, brass, bell metal, bronze, cast iron and special metals.

COLBURN MACHINE TOOL CO., Franklin, Pa. Catalogue C on the Colburn universal saw table which has recently been improved. The construction and attachments are illustrated in a most attractive manner, making an unusually interesting piece of trade literature.

GENERAL ELECTRIC CO., Schenectady, New York. Bulletin No. 4767 on large motors for steel mills. The bulletin illustrates a 6000-horsepower, 6600-volt, 75 R. P. M. induction motor built for the Indiana Steel Co., Gary, Ind., and other steel-mill electrical equipment.

ADAMS CO., 714 White St., Dubuque, Iowa. Booklet entitled "Gear Cutting Speeds" containing data showing the possibility of the hobbing process in cutting gears. Foremen and machine men of gear cutting departments will find the booklet interesting and instructive.

BUFFALO STEAM PUMP CO., Buffalo, New York. Vacuum pump catalogue No. 228, illustrating vacuum pumps and condensers (with and without water seal in stuffing-box), combined air and circulating pumps, power pumps for wet and dry systems, jet condensers, surface condensers, barometric condensers, etc.

ELYRIA GAS POWER CO., Elyria, Ohio. Circular of "Little Big" engines, illustrating and describing the construction of the improved type of gas engine built on the "split unit plan," the construction of which is on the lines of large gas engines having improved valve motion, water-cooled pistons and piston rods, in No. 3 and larger sizes, etc.

FAY & SCOTT, Dexter, Me. Catalogue No. 16 illustrating and describing extension gap engine lathes which are made in seven sizes, as follows: 16-32-inch; 18-36-inch; 20-42-inch; 24-46-inch; 28-52-inch; 32-56-inch, and 38-66-inch swing. The regular lathes are belt-driven, but the company is prepared to furnish them with individual motor drives, if desired.

PAWLING & HARNISCHFEGER CO., Milwaukee, Wis. Folder entitled "Four Laborers instead of Thirty," illustrating how a great saving in cost of handling material was effected in a foundry yard by the installation of Pawling & Harnischfeger traveling bridge crane for handling large quantities of scrap iron, pig, coke and limestone required for running three cupolas.

BRADLEY STOUGHTON, 165 Broadway, New York. Reprint illustrating and describing the Stoughton type converter similar to the Tropenas type for the manufacture of steel for castings. The Stoughton apparatus is adapted to making steel castings of any size from a fraction of a pound to three or four times the weight of one charge of the converter; that is, one ton of the converter can make a three-ton casting, etc.

WHEELER CONDENSER & ENGINEERING CO., Carteret, N. J. Twenty-four page pamphlet entitled "Condensers for Small Central Stations," being a reprint of a lecture delivered before the Missouri Gas, Electric & Street Railway Association. It contains a number of useful tables, charts, and curves relating to the operation and economy of condensing machinery, and other valuable information for engineers concerned with power-plant economy.

VOLCANO TORCH & MFG. CO., Erie Pa. Circular illustrating the "Volcano" torch which generates its own pressure, without the use of an air-pump, and is said to be the most powerful gasoline blow-torch of its size on the market. The "Volcano" torch is made in several styles and weights and with extension burners it is adaptable for boiler repair work and other operations where it would be difficult to apply the burner of a regular torch.

NATIONAL SEWING MACHINE CO., Belvidere, Ill. Catalogue of automatic screw machines with illustrations and descriptions of machines, tools, attachments and product. The machines listed include National automatic turret machine, No. 2; National automatic plain machine, No. 2; National automatic turret machine, No. 3; National automatic plain machine, No. 3; National automatic machine with magazine attachment No. 2; National hand shaver, etc.

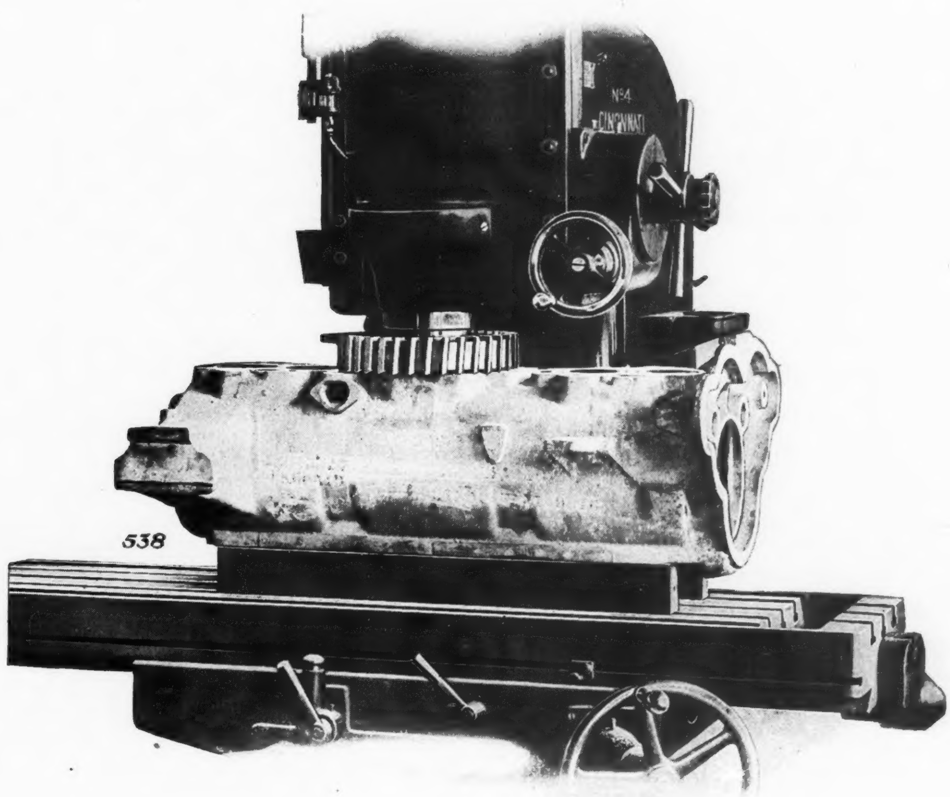
TOPPING BROS., 122 Liberty St., New York. Pamphlet illustrating and describing the "Mechanigraph," a machine for making drawings transparent, and obviating the tracing of pencil drawings. Any opaque paper is rendered transparent by the process so that blueprints may be made directly from drawings thereon without further treatment. The machine is useful also for restoring crumpled and disfigured tracings or drawings to their original smoothness and transparency.

FOSDICK MACHINE TOOL CO., Cincinnati, Ohio. Catalogue of radial drills and horizontal boring, drilling and milling machines. The catalogue illustrates and describes 2½-foot and 4-foot National radial drills, 3-foot standard and 5-foot standard radial drills, 5-foot universal radial drills with gear box and cone pulley drive, No. 0 and No. 1 A and B style horizontal boring, drilling and milling machine. Details of construction of drills and horizontal drilling and milling machines are included.

GENERAL ELECTRIC CO., Schenectady, New York. Bulletin No. 4755 entitled "The Electrification of the Cascade Tunnel on the Great Northern Railway." This interesting pamphlet illustrates the power house, generators, turbine water wheels, transmission lines, locomotives and scenes on the approaches to the tunnel. The tunnel is about 14,000 feet long and has a uniform grade of 1.7 per cent. It was electrified to overcome the great troubles caused by smoke and gases with steam locomotives handling heavy freight trains.

GENERAL ELECTRIC CO., Schenectady, New York. Bulletin No. 4749 on alternating current switchboard panels, three-phase and single-phase types. The panels illustrated are of the sectionalized type, and each section has a separate catalogue number. The panels are made in three sections and the pages of the bulletins are sectionalized so that the user can have before him a picture of the complete panel desired together with a full description of the equipment. The advantage of this ingenious arrangement will be appreciated by those who have to select switchboard equipment.

A Mirror Finish at 20" Per Minute



THE surfaces of these Aluminum Crank Cases are approximately 11″x36″. The illustration shows them being milled on a Cincinnati No. 4 Vertical with a 12″ face mill, 275 rev., 865 cutting speed; for the roughing cut the table is fed to the left, 7¾″ per minute—then reversed, and the feed stepped up to 20″ without stopping, for the finishing cut, which is taken on the return stroke of the table.

The lever for changing the feed is reached from in front of the table; the feed reverse is made by the lever in front of saddle; the operator works both without changing his position.

These finished cases have smooth surfaces, flat under a straight-edge within 0.001 and parallel within the same limits.

This machine will give you similar results on other work of the same character.

Ask for the Catalog.

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI, OHIO, U. S. A.

EUROPEAN AGENTS—Alfred H. Schutte, Cologne, Brussels, Milan, Paris and Barcelona. Donauwerk Ernst Krause & Co., Vienna, Budapest and Prague. Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow.
CANADIAN AGENT—H. W. Petrie, Limited, Toronto, Montreal and Vancouver. AUSTRALIAN AGENTS—Thos. McPherson & Son, Melbourne.
JAPAN AGENTS—Andrews & George, Yokohama. CUBAN AGENT—Adolfo B. Horn, Havana.
ARGENTINE AGENTS—Adolfo Mantels & Co., Buenos Ayres.

CONTENTS FOR OCTOBER

The first column of page numbers applies to the Engineering and Railway Editions; the Second to the Shop Edition

H. H. FRANKLIN MFG. CO., 203 S. Geddes St., Syracuse, N. Y. Catalogue of Franklin die-cast finished parts, illustrating a multitude of die-cast parts for tabulating machines, magnetos, automobiles, telephone and electric work, gearing, computing machines, soda fountain pumps, etc. The Franklin die casting process was originated seventeen years ago and has been highly developed, it being practicable to produce complicated machine parts true to gage with all holes, flanges and threads perfect in every respect, leaving no machine work whatever to be done. The advantage of the process for interchangeable manufacturing of small machines made in large numbers is obvious.

BUFFALO STEAM PUMP CO., Buffalo, N. Y. Catalogue No. 227 on single and duplex steam pumps, simple and compound types, center and outside packed, for all classes of service. A few of the pumps illustrated are: boiler-feed, waterworks, general service, underwriters' fire, tank, high-pressure (up to 2000 pounds per square inch), etc. Barometric and surface condensers, triplex pumps, centrifugal pumps, jet condensers, etc., are also shown, but the company's pump business has developed so broadly that it will issue five catalogues as follows: single and duplex steam pumps (the one here noted), jet, barometric and surface condensers, triplex power pumps, single stage centrifugal pumps and multi-stage centrifugal pumps (in press).

HESS & SON (successors to American Tinol Co.), 1215 Filbert St., Philadelphia, Pa. Circular of "Tinol" paste solder, rod solder, and wire solder, describing the characteristics of "Tinol" and method of use. "Tinol" is a soldering material made of tin and lead in the various proportions required, the same as ordinary solder, but instead of being simply melted together as an alloy and shaped into bars, rods and wires, the alloy is finely granulated, in the case of the paste form, and each grain is thoroughly coated with a flux, the result being that while the solder is in a melted state it is completely protected from the oxidizing influence of the air. The rod and wire forms are made hollow with the core filled with the same flux as that used with the paste.

CINCINNATI PLANER CO., Cincinnati, Ohio. Catalogue of Cincinnati planers, illustrating the company's new plant at Oakley, details of planer construction and the various sizes and styles of planers built. These include Cincinnati 22-inch standard planer, 24-inch, 26-inch, 28-inch, 30-inch, 33-inch, 36-inch (heavy forge), 42-inch, 42-inch (heavy forge), 48-inch, 56-inch, 62-inch, 72-inch, and 84-inch sizes, all standard except those noted. Also 34-inch x 24-inch, 30-inch x 36-inch, 42-inch x 36-inch, 48-inch x 30-inch, 56-inch x 42-inch, 60-inch x 48-inch, 72-inch x 48-inch, all of the widened type. The company's variable speed planers are also illustrated with belt and motor drives. The catalogue is a very handsome production measuring 9½ by 12½ inches and embellished with an illuminated cover showing a typical manufacturing district.

NORTON GRINDING CO., Worcester, Mass. Catalogue of Norton plain machines for cylindrical grinding, illustrating and describing 6-inch by 32-inch machine with overhead and electric drives; 10-inch by 36-inch machine with overhead and electric drives; 10-inch by 50-inch machine with overhead and electric drives; 10-inch by 72-inch machine, 10-inch by 96-inch machine, 10-inch by 120-inch machine, 14-inch by 50-inch machine, 14-inch by 72-inch machine and 14-inch by 96-inch machine, with overhead drives, 14-inch by 72-inch machine, with electric drive; 18-inch by 96-inch machine and 18-inch-30-inch by 96-inch machine, with overhead drives; 18-inch-30-inch by 96-inch machine, self-contained drive; 18-inch by 168-inch machine with overhead drive; 18-inch by 120-inch machine, self-contained drive; 20-inch by 96-inch machine, self-contained drive (for roll grinding); 20-inch and 32-inch by 168-inch machine, self-contained drive; 22-inch by 96-inch machine, special self-contained drive for roll grinding only. Rear and end views of machines are included, also illustrations of details, arrangements of steadyrests, cam-grinding attachments, foundations, etc., making a catalogue of unusual attractiveness and interest to the superintendent, foreman, and mechanic concerned with grinding practice.

TRADE NOTES

LEAVITT MACHINE CO., Orange, Mass., is building an addition to its plant.

CRANDON MFG. CO., Bellows Falls, Vt., a new corporation, is installing machinery for the manufacture of the Crandon electric heat regulators.

AMERICAN PULLEY CO., 4200 Wissahickon Ave., Philadelphia, Pa., is now prepared to furnish its pressed steel belt pulleys up to 60 inches diameter.

HENRY & WRIGHT MFG. CO., 111-137 Sheldon St., Hartford, Conn., states that its sales for the month of August were the largest in the history of the concern.

JAMES SAUNDERS CO., Dayton, Ohio, is making arrangements for constructing a new plant and blacksmith shop for general forging work, and will soon be in the market for new tools for same.

FOOTE-BURT & CO., Cleveland, Ohio, recently added a large erecting floor and otherwise enlarged its plant, thus materially increasing its capacity to meet the increased demand for Foote-Burt drills, etc.

L. S. STARRETT CO., Athol, Mass., announces that its Chicago store is now located in new and larger quarters at 17 N. Jefferson St. A complete stock of Starrett's mechanical tools is carried. Mr. Al. T. Fletcher is manager.

TATE-JONES & CO., INC., Philadelphia, Pa., has received an order from the Frick Co., Waynesboro, Pa., for a large plate heating furnace, 8 feet by 10 feet inside. This furnace will be equipped with the Kirkwood fuel oil burning appliances.

ROCKFORD TOOL CO., Rockford, Ill., manufacturer of engine lathes, moved into its new factory, situated at the corner of 11th and Harrison Ave., October 1. The shop is 64 by 120 feet, and will be equipped with modern machinery throughout.

BAY STATE SCREW CO., Hatfield, Mass., has been sold to the Hatfield Construction Co., a recently organized Massachusetts corporation, which will continue the manufacture of screw machine products, adding new machinery and materially increasing the business.

CINCINNATI BALL CRANK CO., Cincinnati, Ohio, which recently suffered a severe loss through fire, is now established in its new location at 1249 Plum St., and is running full capacity. It is therefore in position to take care promptly and efficiently of any orders received.

ROCKWELL FURNACE CO., 26 Cortlandt St., New York, maker of oil, coal, and gas furnaces and furnace equipment, has opened an office for western business at 718-719 Fisher Building, Dearborn and Van Buren Sts., Chicago, Ill. The office will be in charge of Mr. A. L. Steven, an experienced furnace engineer.

MEAD-MORRISON MFG. CO., Cambridge, Mass., engineer and manufacturer of elevating and conveying machine and hoisting engines, announces a generally good condition of business in its line and states that the plant is working to the extent of its facilities; in fact it has fifty more machinists than ever before at one time.

PAWLING & HARNISCHFEGER CO., Milwaukee, Wis., designer and builder of traveling electric cranes and hoists, has appointed Mr. Arthur Fritsch manager of its Chicago office in the Monadnock Block, Chicago. Mr. Fritsch, who succeeds Mr. W. E. Kreamer, resigned, was formerly connected with the engineering and sales department of the Allis-Chalmers Co.

The Survey for September 3 is devoted to the general subject of human conservation in industries. The issue analyzes the legal and medical aspect as to the length of hours of labor, the question of relief in the case of accidents from both the legal and philanthropic points of view, proper safeguarding and health conditions in industries. *The Survey*, 105 East 22nd St., New York.

NATIONAL MACHINE & TOOL WORKS, Rockford, Ill., has changed its name to the Rockford Milling Machine Co. The company is now located in its new shop having about 9000 square feet of floor space. The company is bringing out a line of power milling machines in addition to its line of hand milling machines and intends to gradually develop a complete line of milling machines for all purposes.

AMERIKA ESPERANTISTO, 700-714 East 40th St., Chicago, Ill., has published a brief grammar of Esperanto which will be sent free to any person sufficiently interested to write for it and enclosing a stamp. The movement for an international auxiliary language now embraces fifty nations in its scope and is of such importance as to warrant the attention of those interested in international trade.

The following concerns were among those exhibiting at the recent Cincinnati Industrial Exposition: Hisey-Wolf Machine Co., Lodge & Shipley Machine Tool Co., Acme Machine Tool Co., Cincinnati Planer Co., Cincinnati Shaper Co., Cincinnati Bickford Tool Co., Cincinnati Pulley Machinery Co., and Triumph Electric Co., all of Cincinnati; Lock Nut Reamer Co., New Haven, Conn., and Link Belt Co., Indianapolis, Ind.